UNIVERSITY OF OREGON BULLETIN

New Series JANUARY, 1915 Vol. XII, No. 5

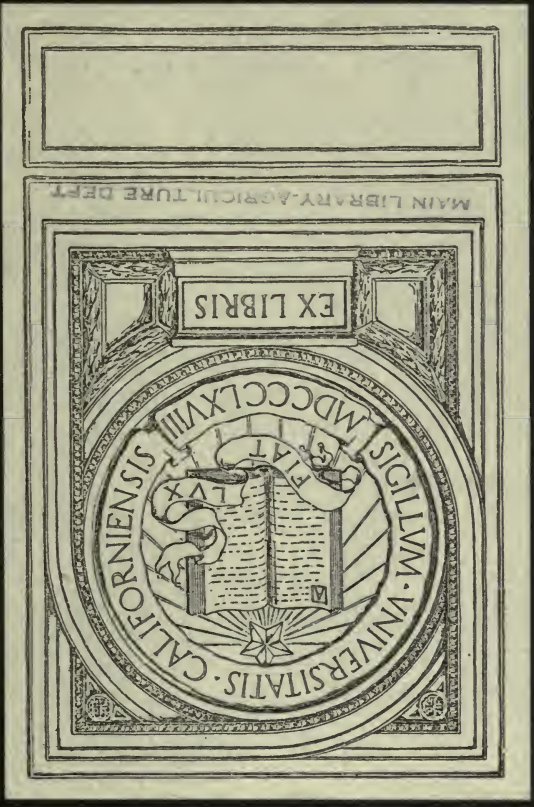
Markets for Potatoes

Markets and Market Conditions. Production. Costs. Prices to Producers. Starch, Alcohol, Stockfood, Flour, and other Industrial Uses of Potatoes. General Information on the Marketing Feature of the Potato Industry, in European Countries and the United States, with special reference to the Pacific Coast States and particularly Oregon.

Issued by the
Department of Commercial and Industrial Survey
University of Oregon School of Commerce
H. B. MILLER, Director

(COMPILED BY J. FREDERIC THORNE)

Published monthly by the University of Oregon, and entered at the postoffice in Eugene, Oregon, as second-class matter.



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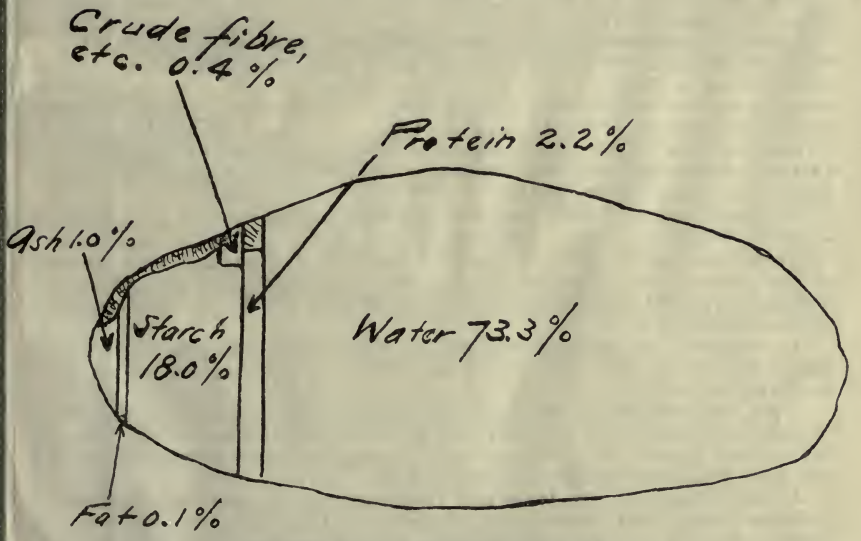

GRAPHIC ANALYSIS OF POTATO
(From "The Potato," by Grubb & Guilford)

INDEX

SUMMARY OF SALIENT FEATURES

The yearly per capita consumption of potatoes in Germany is 7.3 bushels. In the United States, 2.6 bushels. See page 13.

Imports of potatoes into this country now are admitted free of duty. The freight rate on potatoes from Portland to the Atlantic Coast, via the Panama Canal is 30 cents per cwt.

It may be of advantage to combine shipments of potatoes with onions. Care should be taken, though, as onions deteriorate quickly, and a recent shipment through the Panama Canal to New York was almost a total loss due to spoiling. See pages 17 and 28.

While Oregon may not have starch or other factories for the industrial use of potatoes, this is one of the best states of the Union in which to raise hogs, and converting potatoes into pork generally may be a much more profitable process than starch making, a "plant" that every farmer can have close at home. See pages 28-33.

Imports of potatoes into the United States make an investigation of the cost of production and marketing of our crops a very important feature, and a careful study of Tables 2, 3 and the entire chapter on cost data should be of value to the Oregon farmer in demonstrating the competition he must meet and the conditions under which he must meet it. See pages 8, 9, 20-26.

Note the comparative prices received by Oregon producers in 1912, 1913 and 1914, as against the other Far Western states and the average for the United States. See pages 10, 20 and 22.

In considering the above note also the comparative costs of production as shown by Tables 14 and 15. See pages 22 and 23.

At one time the United States supplied the Philippine market with practically all the potatoes used. Now Japan ships large quantities to the Philippines, and practically supplies the entire Asiatic market, driving out the United States from this profitable field.

In Germany the profits of the potato crop and the low cost of fertilizers justify the liberal use of them to an extent not practiced in this country. See page 13.

Until a surplus above the needs for table purposes is produced, and means provided for disposing of it at a profit to the grower, the present succession of fat and lean years must be expected, and just so long potato growing for market will be a speculative enterprise. See page 13.

In competition with the Idaho and Yakima producers, Oregon growers should remember that these districts have lower freight rates to the Southern and Eastern markets, and, generally speaking, a loose sandy soil and climatic conditions much superior for potato growing to that in this State. Their cost of production also is lower, as a rule. See pages 16, 20 and 21.

The world's individual record crop is that produced on the estate of Lord Roseberry, in England, 2,053 bushels per acre, with only 45 bushels of culls. Compared with this the standard of efficiency of the United States is only 4¾%. A standard of 500 bushels really is low, and by proper methods, easily might be raised to 1,000 bushels per acre or more. See page 7.

Of the potato growing countries of the world the United States stands third from the bottom in yield per acre. See pages 7 and 8.

Bermuda potatoes command an average price of $1.44 per bushel in the New York market, owing to their high quality for table use. See Table No. 3, page 9, and page 28.

The largest crop is not always worth the most money. See Table No. 5, page 12.

Prices to producers in Oregon, May 1, 1913 and 1914, were less than half the average for the United States. See Table No. 26, page 27.

Germany leads the world in acreage devoted to potatoes, in total production and average yield per acre, in economy of operation, and in utilization. See page 12.

Human consumption of potatoes in Germany averages over 440 pounds per capita per annum. See pages 12 and 13.

Growers of seed potatoes in Germany are given one-half the regular freight rates on the government railroads. See page 12.

The average wholesale price in cities, for 10 years, in Germany, was 23.67 cents per bushel. In Chicago for the same period, 56 cents. See page 13.

In Germany the potatoes raised for industrial purposes are marketed for about one-third less than table potatoes. See page 13.

Germans plant over 24 bushels of seed potatoes to the acre, and in some cases as high as 35 bushels. See page 13.

When the markets in Germany are over-supplied the Germans do not talk of reducing production, but of finding some new outlet for the surplus. See page 13.

Germany maintains a long rotation between potato crops on the same ground, three to seven years between crops. See page 13.

Germany has solved the problem of supplying a nation with this important foodstuff at a reasonable price regardless of annual variations of yield. The price fluctuation there in five years was only 27 cents per bushel against $1.34 in Chicago. See page 13.

German production in 1914 averaged over a ton for every person in the Empire. See page 8.

Until a surplus above the needs for table use is produced in this country, and means provided for disposing of it at a profit to the grower, the present succession of fat and lean years must be expected, and just so long potato growing for market will be a speculative enterprise in the United States. See page 13.

It is possible that South America offers a good market for Oregon potatoes. See page 28.

Where corn can be grown economically, it is better for stock-feeding than potatoes, and a cheaper source of starch, glucose, alcohol, etc. See pages 29, 31 and 33.

The average European farm laborer gets 39 to 49 cents a day for his labor, without board. See page 15.

Utah is in need of good seed potatoes. See page 17.

In 1911, Idaho shipped all her surplus crop to 32 states of the Union. See page 16.

Prices in Washington rarely go below $10.00 a ton in carload lots. See page 16.

Hill selection of seed means higher quantity, quality, and price. See page 19.

A thorough and exact system of cost keeping is an all important feature of profitable potato marketing. If the grower does not know what his potatoes cost him per bushel, how is he to determine whether it is a profitable crop for him to raise or not? See pages 21 to 26.

It is the starch content of the potato that gives its food and industrial values. See page 28.

Quantity of starch in potatoes varies from 10 to 20%. See pages 28, 31.

There is little encouragement for the building of plants for the industrial utilization of potatoes in the United States on a scale comparable with that in Germany until some change in agricultural conditions gives the manufacturer a cheaper raw material. See page 28.

The margin of profit in manufacturing starch, alcohol, etc., from potatoes is very small. See page 28.

Maine manufactures over 80% of the potato starch made in the United States. See pages 29 and 30.

The price received for potato-starch is, roughly, a little less than twice as much as the cost of the potatoes used. See page 30.

In Germany potatoes particularly rich in starch are grown especially for the starch industry. See page 31.

Average starch content of Oregon potatoes is 19.4%; of California 15.2%. See page 31.

One hundred pounds of potatoes will yield about 16 pounds of starch. See page 31.

It costs to build a starch factory all the way from $8,000.00 to $60,000.00. See pages 32 and 33.

Not more than 25 cents per bushel can be paid for potatoes for the manufacture of starch, profitably. See pages 32 and 33.

Potato-starch is delivered to cotton mills in New England for 3¼ cents to 3⅜ cents per pound. Foreign starch can be landed in Boston for from 3 to 3¼ cents per pound. See pages 32 and 33.

Maine pays 15 to 30 cents per hundred weight for culls for starch making. See page 32.

Five starch factories in Minnesota were sold for junk on account of lack of profit. See page 32.

The market price for potato-starch is controlled by the price of corn-starch, 1½ times the latter is the rule. See page 33.

Approximately 10 pounds of industrial alcohol can be made from 100 pounds of potatoes. Potatoes will have to be produced for at least 15 cents per bushel to compete with Indian corn for alcohol manufacture. See page 33.

German authorities consider their dried potato product to have a feeding value for stock equivalent to 80% of that of American corn. See page 39.

Four tons of fresh potatoes make one ton of dried. See page 36.

19,000,000 swine are supported by potato feed in Germany. See page 39.

Plant for drying 10,000 tons of potatoes costs about $18,000.00. For a small farm-plant about $2,400.00. See page 35.

Dried potatoes are not in competition with the fresh. See page 36.

In 1910 more than 12,000,000 bushels of potatoes were dried in German factories. See page 36.

Cooperative associations and industrial plants may solve the marketing problem. See page 41.

The comparative values of potatoes for various purposes may be summed up as follows, taking 60 cents per bushel as an average farm price paid for table use:

Value for seed	90	cents per bushel
Value for table use	60	cents per bushel
Value for starch manufacture	25	cents per bushel
Value for stock food	20	cents per bushel
Value for alcohol manufacture	15	cents per bushel
Value for flour	12.5	cents per bushel

The average price paid in Germany for potatoes for industrial use is 18.3 cents per bushel. See page 34.

The total potato crop of Great Britain and Ireland is less than the number of bushels used for seed alone by Germany. See page 8.

Over one-fifth of the world's crop of potatoes is grown in Germany. See page 8.

It is in the methods of culture and utilization, rather than soil conditions, that the United States falls behind other countries. See page 14.

Wages for farm labor in Germany averages 39 to 49 cents per day, without board. See page 15.

One-half to two-thirds of the money paid by the consumer never reaches the farmer. See page 15.

Foreign returns per acre are high, but per worker are low. See page 15.

Much of the seed used in California is imported from Oregon. See page 16.

Oregon's most serious competition in the potato markets is from Idaho. See pages 20, 21.

Quality is everything in the potato business. It pays to grade potatoes as carefully as are apples. Appearance is a great aid in marketing. See pages 17, 18 and 19.

The least profitable price to the grower for seed potatoes is 60 cents per bushel. See page 17.

Packing in crates is advisable for long distance shipments. See pages 18 and 28.

Oregon has no local market of moment. See page 18.

Proper ventilation for storage bins is important. See page 18.

Of the Oregon crop 25 to 35 per cent is culls. It should not be over 15 per cent. See page 18.

A thousand farmers have grown rich raising potatoes in New York by maintaining quality. See page 19.

Freight rates are a most important consideration. See pages 10 and 14.

An example of thorough cost keeping data that could well be followed by other growers. See page 24.

Dealers in New Orleans will be glad to get in correspondence with possible shippers from Oregon. See page 28.

The cooler the soil the greater the starch content of potatoes. See page 29.

It is impracticable to ship "green starch" to a central dryer. See page 33.

If the coast districts of Oregon produce 500 to 600 bushels of potatoes to the acre, as is claimed, then that is where a starch factory should be located in the State, if at all. See page 33.

Potatoes have a higher percentage of alcohol than other root crops. See page 33.

The industrial utilization of potatoes has not been established in the United States for several reasons. See page 29.

Germans have found cooperative industrial plants profitable. See page 34.

Distillation of alcohol from potatoes has been of benefit to farmers in Switzerland. See page 35.

Manufacture of unpressed potato meal costs, in Germany, about 56 cents per ton. See page 36.

The Netherlands used over 800,000 tons of potatoes annually for industrial purposes. See page 36.

The United States Agricultural Department is experimenting with wheat flour mixed with potato and other flours to determine their relative values. See page 37.

An acre of potatoes yields ten or more times as much food material as one planted to wheat, rye or peas, but the food value, per pound, is very much less. See page 39.

Care should be taken in the amounts of potatoes fed to stock. See page 39.

Ensilage of potatoes with clover, corn, etc., have proven satisfactory. See page 40.

Potatoes as stockfood are worth about one-fifth of cornmeal, but are of added value as a succulent. See page 40.

AUTHORITIES QUOTED

As far as possible credit has been given in every case to the sources from which the information in this bulletin has been drawn. These sources are indicated by the bracketed letters—as (a)—corresponding with the following list of authorities, unless otherwise stated. Where such source is not specifically given the facts are the concensus of statements made by more than one and condensed for the sake of brevity:

(a)—United States Department of Agriculture.
(b)—United States Department of Commerce and Labor.
(c)—United States Consular Reports.
(d)—Year Book, 1913, United States Department of Agriculture.
(e)—Oregon Agricultural College, Bulletin No. 121, by Prof. H. D. Scudder, Professor of Agronomy.
(f)—Special Consular Report No. 64, "Utilization of Potatoes in Europe," by Robert D. Skinner, Consul-General at Hamburg, Germany, Department of Commerce, 1914.
(g)—Bulletin No. 64, Department Commerce and Labor, Census of Manufactures, 1905, issued 1907.
(h)—Report by C. C. Moore, Assistant Chemist, Department of Agriculture.
(i)—"The Potato," by E. H. Grubb and W. S. Guilford, Doubleday, Page & Co., 1912.
(j)—Cornell University Bulletin No. 341.
(k)—Report by B. H. Warner, Jr., Consul, Leipzig, Germany, August, 1903.
(l)—Report by Consul General A. M. Thackera, Berlin, 1908.
(m)—Report by Consul Norton, Chemnitz, Germany.
(n)—Bulletin No. 47, United States Department of Agriculture.
(o)—Bulletin No. 81, United States Department of Agriculture.
(p)—Farmers' Bulletin No. 65, United States Department of Agriculture.
(q)—Farmers' Bulletin No. 79, United States Department of Agriculture.
(r)—Farmers' Bulletin No. 268, United States Department of Agriculture.
(s)—Farmers' Bulletin No. 295, United States Department of Agriculture.
(t)—Farmers' Bulletin No. 334, United States Department of Agriculture.
(u)—Farmers' Bulletin No. 410, United States Department of Agriculture.
(v)—Farmers' Bulletin No. 570, United States Department of Agriculture.
(w)—Farmers' Bulletin No. 641, United States Department of Agriculture.

Acknowledgement for services rendered is due Roy Johnson, '15, U. of O.

GENERAL REMARKS

The School of Commerce of the University of Oregon has been led to issue this bulletin on the commercial aspects of the potato business by the fact that the vast majority of the farmers of Oregon have met with financial loss and disaster in the marketing of their potato crop for the past three years. It seemed incumbent upon us to attempt to discover a remedy or relief for a commercial situation that is unfortunate and should be unnecessary. That we have tried to do, and trust that the suggestions in the following pages may be of benefit to the potato growers of the State.

The interest being manifested in the production of starch and alcohol from potatoes, and their use industrially in other ways, and the number of inquiries addressed to us for information regarding this feature of the industry, induced the investigation which has resulted in the report given herewith.

When the need and preparation of this bulletin was conceived a conference was held with the Oregon Agricultural College, as it originally was intended that the two institutions should jointly prepare and issue it, the Oregon Agricultural College to supply all the material in regard to production in Oregon and the agronomy features, with suggestions as to the proper selection of seed, preparation of soil, cultivation, etc. Later it was discovered that the O. A. C. had collected the material for, and practically was prepared to issue an independent bulletin covering production in Oregon and the problem of potato-starch manu-

facture. Hence it was arranged for each to issue a separate bulletin and by mutual arrangement avoid any duplication of material insofar as was possible and practicable.

No attempt, except in a very general way and by inference, will be made herein to deal with the questions of the best methods of growing potatoes, varieties, culture, necessary soil and climatic conditions, etc., except as they may directly affect marketing conditions or the price of production, as in the use of fertilizers, irrigation, etc. It is as a commodity of commerce after it is grown that we would deal with the potato. This is not to say that the agricultural features are not equally important, for they are; nor that they do not affect both cost and value of production, for they do most materially; but only that there is a broad division between the two elements of the potato business. The Oregon Agricultural College deals with problems of production and in this bulletin we are considering the financial and market feature primarily. (See O. A. C. Bulletin.)

There is some conflict in figures derived from different sources as answers to the same question—very considerable differences in some instances. When these conflicts in authority occur, we have, except when the source is specifically stated, taken the figure that seems to be the most reliable, given the average of all secured, or quoted the various reports separately.

PRODUCTION IN FOREIGN COUNTRIES AND IN THE UNITED STATES

(a) A comparative statement of the amounts of potatoes produced in the principal potato raising countries and in the several states of this country in 1912, according to the latest world figures available: N. B.—This is the largest yield for any single year that is recorded, for the world and also for the United States.

TABLE No. 1. (*d*) *Acreage Planted and Production of Potatoes in Countries Named, 1912*

Country	Acres	Bushels	Av. yield per acre. Bushels
United States	3,711,000	420,647,000	113.4
Canada	484,000	84,885,000	175.4
Newfoundland	.....	1,524,000	.....
Mexico	.....	924,000	.....
Argentina	278,000	38,029,000	136.8
Chili	66,000	9,656,000	146.3
Germany	8,257,000	1,844,863,000	223.5
Austria-Hungary	4,879,000	683,779,000	149.0
France	3,863,000	552,074,000	145.8
United Kingdom	1,208,000	213,783,000	177.0
Netherlands	426,000	121,878,000	286.1
Belgium	387,000	121,481,000	313.9
Italy	712,000	56,313,000	79.0
Russia (European)	11,167,000	1,356,824,000	121.5
Spain	632,000	93,089,000	147.3
Sweden	378,000	65,765,000	173.9
Switzerland	.....	46,712,000	.....
Japan	173,000	25,669,000	148.3
Africa	.....	5,407,000	.....
Australasia	159,000	16,666,000	104.8
Total of above and for world	.....	5,898,531,000	.....

It will be seen from Table No. 1, that the United States stands third from the bottom in yield per acre, that Belgium produces over 200 bushels more per acre than we do, and that Germany doubles our yield per acre. The difference

is even more marked if individual farms in Germany may be used for comparison, some of these producing 600 to 1,000 bushels to the acre. The world's individual record crop is that produced on the estate of Lord Roseberry, in England, 2,053 bushels per acre, with only 45 bushels of culls. Compared with this our standard of efficiency is only 4¾ per cent. A standard of 500 bushels per acre really is low, and, by proper methods, where conditions are favorable, easily might be raised to 1,000 bushels, or more.

Note also that Germany, with a total area less than that of Texas, plants about five million more acres than the entire United States. Germany's potato acreage is more than double and the yield more than four times that of the United States. The total crop of Great Britain and Ireland is less than the number of bushels used for seed alone by Germany. Over one-fifth of the world's crop is grown in Germany. The German crop for 1914 exceeded 80 million tons, or over a ton for every man, woman and child in the Empire.

The average yield in bushels per acre for a period of nine years, 1903-12, for the principal countries were: United States, 96.0; Russia, 104.6; Hungary, 116.8; France, 129.5; Austria, 152.4; Germany, 196.8; United Kingdom, 202.4.

TABLE No. 2. (*a*) *Acreage, Production, Prices, Exports and Imports in the United States, 1901 to 1914 (fiscal years) inclusive.*

Year	Acreage planted and harvested. Acres	Average yield per acre. Bushels	Production. Bushels	Average farm price per bushel Dec. 1. Cents	For fiscal year ending June 30	
					Exports. Bushels	Imports. Bushels
1901	2,611,000	80.8	210,927,000	43.1	741,483	371,911
1902	2,864,000	65.5	187,598,000	76.7	528,484	7,656,162
1903	2,966,000	96.0	284,633,000	47.1	843,075	358,505
1904	2,917,000	84.7	247,128,000	61.4	484,042	3,166,581
1905	3,016,000	110.4	332,830,000	45.3	1,163,270	181,199
1906	2,997,000	87.0	260,741,000	61.7	1,000,326	1,984,160
1907	3,013,000	102.2	308,038,000	51.1	1,530,461	176,917
1908	3,128,000	95.4	298,262,000	61.8	1,203,894	403,952
1909	3,257,000	85.7	278,985,000	70.6	763,651	8,383,966
1910	3,525,000	106.8	376,537,000	54.9	999,476	353,208
1911	3,720,000	93.8	349,032,000	55.7	2,383,887	218,984
1912	3,619,000	80.9	292,737,000	79.9	1,237,276	13,734,695
1913	3,711,000	113.4	420,647,000	50.5	2,028,261	337,230
1914	3,668,000	90.4	331,525,000	68.7	.....	.....

Note that the years in Table No. 2 are fiscal and not calendar. The importation for 1912 was the largest in the history of the United States, the next nearest being 1909. The lowest, since 1852, was in 1907. For the calendar year of 1914 the total production was 405,921,000 bushels; value $198,609,000; average yield per acre 109.5 bushels; farm price 48.9 cents per bushel. The average price to producers on July 1, 1914, was 81.5 cents per bushel.

TABLE No. 3. (*b*) *Imports from Countries Named, Years Ending June 30, 1909-1913.*

Imported from	1909		1910		1911		1912		1913		Six months ending Dec. 1, 1913	
	Bushels	Dollars	Bushels	Dollars	Bushels	Dollars	Bushels	Dollars	Bushels	Dollars	Bushels	Dollars
Austria-Hungary	1,331	657	7	4	.....	.....	486	388	184	118	.....	.....
Belgium	200,932	109,699	59	35	7	8	336,291	185,010	2,065	1,421	996,255	453,167
Denmark	1,912	625	.....	.....	.....	.....	3,155	1,925	2,107	1,160	117,649	51,968
France	124,367	60,401	7,674	4,316	1,926	1,999	242,719	124,979	5,784	4,234	9,610	4,482
Germany	79,024	44,373	39,135	23,626	34,675	20,902	54,849	37,975	11,569	6,866	.....	.....
Italy	15	15	12	11	13	14	2,731	1,681	36	20	530	138
Netherlands	74,697	26,352	17,551	7,222	9,827	4,851	121,626	62,805	17,607	7,644	722,340	293,973
Spain	9,144	7,333	1,182	856	1,379	1,123	3,567	2,660	1,629	1,123	196	120
England	1,785,298	725,037	734	407	105	108	3,377,426	1,716,305	.....	.....	.....	.....
Scotland	2,684,588	1,099,858	100	70	136	97	4,645,877	2,262,969	.....	.....	24	80
Ireland	1,975,877	814,898	1,219	310	22	7	4,606,981	2,361,920	.....	.....	13,777	6,466
Bermuda	139,590	176,315	134,864	185,936	101,479	151,521	131,709	218,616	141,422	203,074	14,963	21,597
Canada	1,181,693	549,029	97,138	36,770	23,832	10,238	143,159	128,076	119,493	42,696	988,493	444,066
Mexico	47,272	48,829	28,013	27,716	16,266	15,893	18,879	18,462	8,301	6,239	29,460	22,427
West Indies	351	297	528	507	169	128	1,541	2,599	218	134	262	121
Cuba	9,351	8,402	6,892	5,997	12,166	11,714	4,143	3,803	725	648	328	211
China	566	608	655	727	864	932	894	1,066	312	344	9	10
Hong Kong	137	120	26	17	183	156	113	99	8	12	9	26
Japan	28	59	71	69	136	126	1,450	915	429	389	648	583
Canary Islands	7,569	6,918	16,938	12,095	15,753	15,982	31,800	34,217	25,015	26,875	4,614	4,250
Total—including other countries	8,383,966	3,677,034	353,208	306,815	218,984	235,847	13,734,695	7,168,627	337,230	303,214	2,902,075	1,305,029
Recapitulation—												
Europe	6,997,238	2,889,288	68,083	36,981	48,090	29,109	13,400,896	6,760,704	41,147	22,663	.....	.....
North America	1,378,263	779,876	267,435	256,926	153,920	189,504	299,337	371,560	270,162	252,793	.....	.....
South America	5	2	.....	.....	33	35	5	5	.....	.....	.....	.....
Asia	731	787	752	813	1,188	1,217	2,657	2,141	786	764	.....	.....
Oceania	160	163	.....	.....	.....	.....	.....	.....	110	113	.....	.....
Africa	7,569	6,918	16,938	12,095	15,753	15,982	31,800	34,217	25,025	26,801	.....	.....

The salient features of Table No. 3 are: The heavy importations from Belgium, England, Ireland, Scotland, Bermuda, Canada, and, by comparison, from the Canary Islands; the latter receiving approximately $1.00 per bushel for the potatoes they ship to this country; Mexico, Cuba, and Japan get about the same. Note also the wide fluctuations in the various years in imports from Belgium and Great Britain. (See chapter on Possible Markets, this bulletin.)

TABLE No. 4. (a) *Acreage, Production, Average Yield Per Acre, Farm Price Per Bushel, and Farm Value Per Acre, by States, 1912-1913.*

States	Acreage 1912, Acres	Acreage 1913, Acres	Production 1912 Bushels	Production 1913 Bushels	Av. yield per acre. Bushels, 1912	Av. yield per acre. Bushels, 1913	Av. yield per acre. Bushels, ten years, 1900-1909	Farm price per bushel Dec. 1, in cents, 1912	Farm price per bushel Dec. 1, in cents, 1913	Av. farm price per bu. Dec. 1, in cents, 1900-19.9	Value in dollars per acre. 1913
Maine	117,000	128,000	23,166,000	28,160,000	198	220	180	55	53	56	$ 116.60
New Hampshire	17,000	17,000	2,380,000	2,074,000	140	122	114	61	83	66	101.26
Vermont	26,000	25,000	3,640,000	3,175,000	140	127	113	55	72	55	91.44
Massachusetts	26,000	27,000	3,380,000	2,835,000	130	105	103	75	85	78	89.25
Rhode Island	5,000	5,000	565,000	650,000	113	130	124	77	90	82	117.00
Connecticut	23,000	24,000	2,461,000	2,208,000	107	92	95	78	87	80	80.04
New York	360,000	360,000	38,160,000	26,640,000	106	74	88	58	80	59	59.20
New Jersey	92,000	94,000	9,936,000	8,930,000	108	95	97	66	82	72	77.90
Pennsylvania	265,000	265,000	28,885,000	23,320,000	109	88	82	57	80	64	70.40
Delaware	11,000	11,000	1,100,000	957,000	100	87	82	70	75	64	65.25
Maryland	37,000	43,000	4,144,000	3,741,000	112	87	80	58	67	61	58.29
Virginia	95,000	105,000	8,265,000	9,870,000	87	94	79	65	80	64	75.20
West Virginia	47,000	48,000	5,264,000	3,984,000	112	83	86	62	90	66	74.70
North Carolina	30,000	30,000	2,550,000	2,400,000	85	80	73	76	82	73	65.60
South Carolina	10,000	10,000	900,000	800,000	90	80	79	112	130	105	104.00
Georgia	12,000	12,000	936,000	972,000	78	81	72	87	105	100	85.05
Florida	11,000	12,000	1,023,000	912,000	93	76	81	110	117	119	88.92
Ohio	186,000	160,000	20,832,000	10,240,000	112	64	84	53	85	59	54.40
Indiana	87,000	75,000	9,918,000	3,975,000	114	53	79	50	84	60	44.52
Illinois	137,000	125,000	13,837,000	5,750,000	101	46	85	60	89	64	40.94
Michigan	350,000	350,000	36,750,000	33,600,000	105	96	88	41	53	44	50.88
Wisconsin	291,000	295,000	34,920,000	32,155,000	120	109	92	34	54	45	58.86
Minnesota	245,000	275,000	33,075,000	30,250,000	135	110	88	28	52	44	57.20
Iowa	174,000	150,000	18,966,000	7,200,000	109	48	82	46	82	53	39.36
Missouri	95,000	85,000	7,980,000	3,230,000	84	38	81	69	93	62	35.34
North Dakota	52,000	60,000	6,656,000	5,100,000	128	85	94	28	56	46	47.60
South Dakota	62,000	60,000	6,510,000	4,680,000	105	78	83	36	63	49	49.14
Nebraska	118,000	118,000	9,440,000	5,664,000	80	48	83	51	78	55	37.44
Kansas	70,000	73,000	5,740,000	2,920,000	82	40	76	73	91	73	36.40
Kentucky	51,000	50,000	5,151,000	2,450,000	101	49	74	67	102	65	49.98
Tennessee	38,000	38,000	3,344,000	2,432,000	88	64	70	70	97	67	62.08
Alabama	15,000	18,000	1,215,000	1,512,000	81	84	73	90	105	95	88.20
Mississippi	10,000	12,000	890,000	960,000	89	80	82	90	100	92	80 00
Louisiana	20,000	25,000	1,460,000	1,750,000	73	70	66	83	96	88	67.20
Texas	52,000	45,000	3,276,000	2,340,000	63	52	66	105	112	97	58.24

Oklahoma	29,000	32,000	1,740,000	1,920,000	60	60	76	93	105	88	63.00
Arkansas	25,000	25,000	1,750,000	1,800,000	70	72	70	92	100	81	72.00
Montana	37,000	36,000	6,105,000	5,040,000	165	140	150	40	67	57	93.80
Wyoming	11,000	12,000	1,540,000	1,680,000	140	140	145	60	65	67	91.00
Colorado	85,000	80,000	8,075,000	9,200,000	95	115	130	41	65	60	74.75
New Mexico	9,000	9,000	900,000	612,000	100	68	77	65	140	94	95.20
Arizona	1,000	1,000	125,000	75,000	125	75	.....	125	135	.....	101.25
Utah	19,000	20,000	3,515,000	3,600,000	185	180	144	49	58	50	104.40
Nevada	12,000	11,000	2,136,000	1,760,000	178	160	155	60	68	75	108.80
Idaho	35,000	34,000	6,475,000	5,780,000	185	170	148	29	50	53	85.00
Washington	68,000	60,000	11,356,000	7,380,000	167	123	134	36	60	50	73.80
California	78,000	68,000	10,140,000	8,092,000	130	119	125	65	70	71	83.30
Oregon	65,000	50,000	10,075,000	6,750,000	155	135	109	31	58	58	78.30
United States....	3,711,000	3,668,000	420,647,000	331,525,000	113.4	90.4	91.4	50.5	68.7	57.4	$ 62.13

As potato growers the Utah and Idaho farmers tied in 1912, raising 185 bushels per acre. Maine farmers grew 198 bushels by the lavish use of fertilizers, hence are not in the same class as their western brethren. The average yield for the United States was 113.4 bushels per acre.

(a) While both the average yield per acre and the total yield for the United States were greater in 1912 than in 1913, the crop for the latter year was the more valuable in dollars. The comparative figures are:

(a) TABLE No. 5.

Year	Acreage	Average yield per acre, bu.	Production bushels	Average farm price per bu. Dec. 1. cents	Farm value Dec. 1
1912 ..	3,711,000	113.4	420,647,000	50.5	$212,550,000
1913 ..	3,668,000	90.4	331,525,000	68.7	227,903,000

Comparisons to determine the actual needs of the country, prices and values, cannot fairly be made with the 1912 crop, which was so large that hundreds of thousands of bushels went to waste for lack of a market, and millions of bushels were sold for less than the cost of production.

The annual production of potatoes in the world is estimated, roughly, to be seven billion bushels per year, about double the amount of wheat.

As the yield per acre in Europe is three to four times, or more, that of the United States, it may be well to consider some of the facts concerning foreign countries, especially Germany, as that country leads the world in acreage devoted to potatoes, in total production and average yield per acre, in economy of operation, and in utilization, it being the only country that makes any considerable industrial use of potatoes.

(f) Production in Germany has advanced steadily to an average which now exceeds 45 million tons, of which 4 per cent is used for the manufacture of starch and by-products, and 8 per cent for alcohol. . . . At the present time over 200 varieties of potatoes are raised in Germany, the most of which are used indifferently for all purposes. . . . Freight is only $3.89 per ton to America. . . . Production in Germany: tons: 1905, 48,323,353; 1906, 42,936,702; 1907, 45,538,299; 1908, 46,342,726; 1909, 46,706,252. . . . Average wholesale prices, Berlin, for good table potatoes (per 1,000 kilos or 2,200 pounds, exclusive bags), 1905, $12.71; 1906, $8.23; 1907, $12.64; 1908, $12.85; 1909, $11.88. . . . Human consumption now averages over 440 pounds per capita per annum, and cannot be increased except as population increases.

(f) In Germany the standard varieties according to which the value of all new cultivations are measured, are the "Daber," of South American origin, and as a type of food potato "Richter's Imperator." For 38 years the latter has proved to be of the highest value, yielding and resisting about the same from year to year.

The distribution of reliable seed potatoes at low rates is effected by the recognition of seed-potato farms, whose owners are authorized to ship supplies on government railroads at one-half the ordinary freight rates.

TABLE No. 6—*The following table contains some officially reported German prices per bushel of 60 pounds.*

Year	Berlin		Breslau	Magdeburg
	Early Red for distilling. Cents	Table potatoes. Cents	Cents	Cents
1902	12.68	23.43	18.26	13.06
1903	17.00	29.06	23.29	16.81
1904	23.89	36.00	34.69	21.88
1905	23.62	34.56	32.63	21.60
1906	13.19	22.39	21.50	13.71
1907	19.35	34.37	26.29	18.26
1908	21.09	34.97	24.41	19.54
1909	20.54	32.34	26.34	20.52
1910	17.09	26.34	23.18	16 81
1911	22.72	38.64	35.81	25.11
Average, 10 years	19.12	30.21	26.64	18.73

(The average of all the above is 23.67 cents per bushel, which may be compared with the average Chicago price for ten years of 56 cents.)

It will be seen by Table No. 6 that the potatoes raised for industrial purposes in Germany are marketed at about one-third less than table potatoes, and that the highest price paid at any time for any quality in ten years would be considered quite low in the United States.

(n) Germans plant over twice as many seed potatoes per acre as is the custom here, or more than 24 bushels. Another statement gives 1780 pounds as the average allowance of seed per acre in Germany, although on many highly cultivated and progressive farms they use as much as 1,960 pounds (35.1 bushels) per acre. In Germany the low cost of fertilization and the profits of the potato crop justify the liberal use of commercial fertilizers; 1,000 to 1,200 pounds of phosphate or bone dust is used per acre, and almost unlimited quantities of potash. The average expenditure for potato manures on 140 German estates was $10.68 per acre. The yields per acre of all farm crops have been greatly increased since the extension of potato growing. The German farmers seek to plant a maximum acreage of potatoes, and when, through the abundance of their harvests, their various markets are oversupplied, there is not so much talk of reducing production as of finding some new outlet for the surplus. Germany has a long rotation, three to seven years between potato crops, the United States having only the beginning of an ordered system. The importance of green manuring is not yet fully appreciated here. Thorough preparation of the land and frequent thorough cultivation are essential. Those American farmers who have mastered these points of manuring, rotation, and culture are producing crops which approach European standards. The cost of production in the United States is, however, higher than it should be. The situation in this country is very bad from an economic standpoint. Both producer and consumer suffer in the long run. The farmer runs too great a risk, and the retail price of potatoes frequently exceeds their food value. The problem of supplying a nation with this important food stuff at a reasonable price regardless of annual variations of yield, has been solved by Germany. The half of the German crop destined for stock food, alcohol and starch, constitutes an inexhaustible reserve from which deficiencies in the supply of table potatoes may be filled. That this is effective is shown by the fact that the differences between the highest and the lowest average monthly prices in Berlin during five years was only 27 cents per bushel, while the fluctuation in Chicago during the same five years was $1.34. Until a surplus above the needs for table purposes is produced in the United States, and means provided for disposing of it at a profit to the grower, the present succession of fat and lean years must be expected, and just so long potato growing for market will be a speculative enterprise. We must hereafter produce enough potatoes to supply all our needs, as most sources of foreign imports have been closed by a plant disease quarantine.

(n) The potato stands next to the cereals as the most important food of northern nations. In Germany this is particularly true, for the per capita consumption is 7.3, while ours is estimated at 2.6 bushels. The well-to-do people there use 3.6 bushels per annum, the peasantry 8.8 bushels, while the poorer laborers use 17 bushels each per year.

(n) In Germany 40 per cent of the crop is fed to stock; 28 per cent is used for table purposes; 12 per cent for seed; 6 per cent for alcohol; 4 per cent for starch and related products, and 10 per cent decay.

(f) In present state of industrial use the normal applications of the German crop are about:

Table No. 7.

Manufacture of spirits	2,500,000 tons
Manufacture of starch	1,400,000 tons
Manufacture of dried potatoes	400,000 tons
Human consumption	13,000,000 tons
Replanting	6,000,000 tons
Loss from decay and other causes	4,000,000 tons
Exports (in 1912)	124,582 tons
Total	27,424,582 tons

The difference between the above total requirements and the entire crop is the quantity used as fodder in the form of fresh potatoes, a utilization much more common in Europe than in America.

(f) The above may be compared with the following estimate for the United States: Used for: Human food, 68 per cent; seed, 11 per cent; stock feed, 5 per cent; starch, 1 per cent; loss, 15 per cent. There is no appreciable per cent used for the manufacture in the United States of alcohol, dried, dessicated, or potato flour.

(c-1903) Of the total quantity of potatoes stated as being consumed for food, it might perhaps be roughly estimated that about 50 per cent really is consumed by human beings. The rest is spent in cleaning, paring and cooking, wasted, disappears in shrinkage due to loss of water by evaporation, and fed to animals in a raw or cooked state.

TABLE No. 8—*Comparative figures for Germany and the United States, December 1, 1899-02.*

Year	Farm values, Germany, per bushel		United States per bushel	Market value of yield per acre	
	For manufacturing uses	For human food		Germany	United States
	Cents	Cents	Cents		
1899	17.59	23.56	39.0	$41.98	$34.55
1900	19.80	26.96	43.1	49.25	34.82
1901	14.67	22.70	76.7	47.98	50.27
1902	12.62	20.90	47.1	39.92	45.22

The distilleries and starch factories in Hungary use annually approximately 13 million bushels of potatoes.

Prices in France average about 1¾ cents per pound for table potatoes, and ½ cent a pound for industrial purposes.

England produces between 7 and 8 tons per acre.

Land values in Holland vary from $100 to $350 per acre, the average yield for 1912 was 300 bushels per acre, and 500 bushels per acre for potatoes used for industrial purposes. Average price received, 85 cents per bushel for table use, and 20 to 35 cents per bushel for the flour industry.

The average yield for Ottawa, Canada, is 116 bushels per acre; this is increased to 300 by good cultivation, and 400 to 500 is quite possible, according to the Dominion Horticulturist. He also states the cost to average $50 per acre, plus $6 for fertilizer; shipping to seaboard, 20 cents per bushel; and labor cost $1.75 to $2 per day without board.

(From "Farmers of Forty Centuries"—China, Korea, Japan—by F. H. King.) "A gardener, growing potatoes near Tientsin, China, obtained a yield, when sold new, of 8,000 pounds per acre, and of 16,000 pounds when permitted to mature. The new potatoes were sold so as to bring $51.60 and the mature potatoes $185.76 per acre, making the earning for the two crops the same season $237.36 gold. By planting the first crop very early these gardeners secure two crops the same season, in a district as far north as Columbus, Ohio, and Springfield, Illinois. The rental for the land and fertilizers in this case amounted to $30.96 per acre.

"One farmer in Japan secures a yield of 352 to 361 bushels of potatoes per acre, which at the market price would give a gross earning of $64 to $66 per acre."

(n) "The disparity in the average yields of Germany, and other foreign countries, and the United States, is not due to the superior quality of their soils. It is in methods of culture and utilization that we fall so far behind. We need longer rotation, more fertilizing and cultivation, more seed per acre, and greater care from first to last, if we are to compete with foreign countries in quality and quantity of production . . . Almost all foreign countries that have suitable climatic conditions for potato growing excel the United States in both quantity per acre and quality."

In many states in this country corn can be grown more economically, is better for stock feeding, and is a cheaper source of starch, glucose and alcohol.

The high cost of farm labor in the United States as against Europe is an important factor. It is stated that the average daily wage for a farm laborer in Germany, Belgium, France, etc., is from 39 to 49 cents per day, without board; when board is furnished it is about one-third less.

(j) From one-half to two-thirds of the money paid by the consumer never reaches the farmer. The difference is cost of transportation from field to table. Foreign yields per acre are attractive, but secured at what a cost! Women and children must work in the fields in order to live. The returns per acre are high, but per worker they are low. It is estimated that the American farmer, due possibly to machinery and power, produces twice as much per worker as does the Belgian peasant, and five times as much as the Chinese.

CONDITIONS IN PACIFIC COAST STATES

In addition to statements included in the foregoing, the following facts concerning conditions in the Pacific Coast states are pertinent.

The following table was published in the Portland Oregonian, of June 25, 1914:

TABLE No. 9—*Prospective Potato Output.*

	Acreage		Yield, Bushels	
	1914	1913	1914	1913
Oregon	60,000	50,000	12,000,000	8,750.000
California	60,000	52,000	12,000,000	6,000,000
Washington	58,000	51,000	11,600,000	8,825,000
Idaho	34,000	29,000	6,800,000	5,222,000
Total	212,000	182,000	44,400,000	28,547,000

TABLE No. 10—*John W. Gilmore, of the Agricultural Experiment Station, University of California, gives the following figures for California:*

Year	Acreage	Average per acre	Production	Average farm price, cents per bu. Dec. 1	Farm value Dec. 1
1908	49,000	107	5,243,000	77	$4,037,000
1909	60,000	130	7,800,000	77	4,006,000
1910	70,000	130	9,100,000	85	7,735,000
1911	72,000	135	9,720,000	90	8,748,000
1912	78,000	130	10,140,000	65	6,591,000

TABLE No. 11—*A. J. Cook, California Commissioner of Horticulture, issues the following table under date of May 11, 1914, for California:*

Production, bushels	9,720,000
Acres under cultivation	62,000
Average yield per acre, bushels	135
Average price per bushel, cents	90
Total value	$8,748,000
Imports, 1911, bushels	216,984
Imports, 1911, value	$ 235,847
Exports, 1911, bushels	2,383,887
Exports to foreign countries, 1911, value	$1,535,630

No data is given on cost of production, which is estimated to be $60 per acre. No figures on exports to other states. Value of land, $200 to $300 per acre. Very little fertilizer used. While average yield is 135 bushels, it often runs up to 300 bushels per acre.

(i) *California:* The San Francisco markets recognize three grades of potatoes —sorted, over and under sized; and standard market. The latter is said to pay all expenses, the income from the others being figured as profit.

Potatoes are grown in a large commercial way in three regions: Stockton vicinity of the San Joaquin Valley; Salinas and Lompoc Valleys along the coast. Lompoc yield averages 150 to 200 bushels per acre; seed is imported and changed every two years. Salinas Valley imports every three years. Stockton crop for 1910 was valued at $2,145,000; potatoes in this district are in the ground and shipments from Stockton are made continually throughout the year. The Lompoc Valley has a total area of less than 15,000 acres; the district is one of small

farms, forty acres being the average size. The average yield is 150 to 200 bushels per acre. Lompoc is unique in that potatoes of the very highest quality are grown at a low altitude and a southern latitude. Some extra large potatoes are grown, and "Peerless," a big rough variety here, yields up to 400 sacks per acre. Lompoc seed is imported almost entirely from Oregon, and is used two years before another change is made, about 600 pounds per acre being the average amount used. The quality of the Lompoc and Salinas potatoes is such that they generally bring $1 to $1.50 per cwt. as they come from the field. The crop is graded into: Firsts—smooth, even, medium-sized potatoes; seconds—small, large and uneven potatoes, but all sound; thirds, or "cow feed"—all cut, bad and very small tubers.

Conditions in the Salinas Valley are very similar to Lompoc. Seed is imported from Oregon every third year by many growers. The Burbank variety is grown exclusively.

The Stockton district is now one of the biggest potato-producing sections in the world, area considered. The potatoes are taken to railroad shipping points on boats, and commission men and dealers re-sort before selling to retailers. Practically the entire crop in the district is grown by Japanese, Chinese, Portuguese and Hindus. Large areas are rented at from $12 to $30 per acre and sublet in smaller lots on a share basis, the landlord furnishing land, implements, and seed for 49 per cent of the crop. Seed of the Burbank variety from Oregon is universally used, new seed being secured every two years. Eight sacks—of about 100 pounds each—of cut seed are planted per acre, and the yield is from 80 to 150 sacks per acre. Potatoes are never planted twice in succession in the same ground.

(i) *Idaho:* In the Burley potato contest in 1910 the prize production on one acre was 38,685 pounds gross weight. The weight of culls was 4,150 pounds, making 34,535 pounds, or 575½ bushels of marketable potatoes. The variety was Dalmeny Challenge. Idaho shipped last season 8,468 carloads to Texas, Oklahoma, Louisiana, Kansas, Tennessee, Colorado, Arkansas, Nebraska, Iowa, Illinois and California.

Idaho production is 400 bushels in many cases, and 806 bushels per acre were raised on four acres near Rupert.

In his report for 1911-12, S. J. Rich, Idaho Commissioner of Immigration, Labor and Statistics, says:

"With soil that is right, a regulated moisture supply through irrigation, an ideal climate, and freedom from fungus diseases, it is easy to understand why Idaho has become famous as a potato producing state. There are several districts in Idaho where trainloads of potatoes are sent out from single stations every day for several weeks in the fall and early winter—not merely in carloads, but in trainloads. In 1912 there were 46,193 acres of potatoes grown in Idaho, which yielded a total of 7,986,065 bushels. The average yield per acre was 172.8 bushels. According to government statistics the State of Idaho in 1911 tied with Maine for honors for first place in yield per acre at 180 bushels per acre, about double the average yield per acre for the United States. . . . In 1911 Idaho shipped all her surplus crop to 32 states in the Union. Many markets used Idaho potatoes for the first time." See pages 20 and 21.

(i) *Washington:* "There is little danger of overstocking the market for potatoes here. The Eastern demand for Washington grown potatoes is good and rarely has allowed the price to fall below $10 per ton in car lots in the past. In addition to this there is a rapidly increasing market in Alaska. There is no crop now grown in Washington which shows greater variation in yield per acre than the potato. This is largely because of an erroneous idea that potatoes as a crop do not need much attention. The grower who exercises proper care with his potatoes always is repaid in the yield and quality of his crop. The average cost of producing potatoes in Eastern Washington is a little less than $5 per ton, or less than one-half cent per pound.

(i) *Nevada:* The average yield is about six tons to the acre, or 200 bushels, under any reasonably skillful handling, but the leading potato growers of the state grow from eight to fifteen tons per acre. The average selling price is about $20 per ton, or 60 cents per bushel. A net profit of $200 per acre is not unusual in seasons of good prices.

(i) *Utah:* In 1910 Utah produced an average of 152 bushels per acre. The seed is mostly home grown and as a rule is not well selected. The main factor contributing most to the discouragement of the potato growers of this state is the lack of good seed. Utah potatoes were shipped last year (1911) to Cheyenne, Wyoming; Butte and Helena, Montana; Denver and Pueblo, Colorado; Topeka, Kansas; Kansas City, Missouri; Austin, Houston and Galveston, Texas; San Francisco, Sacramento and Los Angeles, California; Portland, Oregon; Spokane, Seattle and Tacoma, Washington.

(i) *Colorado:* "As to markets, we have Texas first. This is a short haul and quick service; that is, the Texas people can get 'spuds' from Greeley quicker than from any other section, and the freight rates are as low and some lower than in a great many of the potato districts. Again, we have onions which we are privileged to ship with potatoes, and the smaller towns which could not use a car of onions will buy the potatoes in order to get 20 or 30 sacks of onions in the car. . . . Different localities use a different style of potato. For instance, Chicago wants a rather large, long potato; St. Louis a round, medium size; and Kansas City demands the very largest."

Lon D. Sweet, the Colorado potato king, says it is easier to grow good potatoes than poor.

"What people want is a smooth, regular potato weighing about half a pound. For certain purposes larger sizes may be desirable, but for the general market the medium size is preferred.

"Potatoes should be sized and graded as carefully as apples. It pays to do this, and to put them up for market in attractive packages. Our potatoes, selected and graded in this manner, and put up in new sacks, sold for $2 right along this season, when the best potatoes from anywhere, packed in the ordinary way and of irregular size, brought from 80 cents to $1.15 and $1.20.

"To grow the right kind of potatoes you must do just as you do when you breed fine cattle. Your seed must be selected. If you plant runty, diseased seed, you harvest diseased runts. Seed potatoes should be selected from hills which have produced from 10 to 12 potatoes of the kind sought, good even size and healthy. Then plant the whole potato—don't cut your seed potatoes.

"Rotate your crops to insure healthy and well fertilized soil. See that the proper amount of water is given, and that the crop is well cultivated. There's no secret about it. Anybody can raise good potatoes if they will give it thought and attention."

(e) *Oregon:* Too much importance cannot be placed upon the importance of seed growing and seed selection in securing, improving and holding markets for Oregon potatoes. If the farmers of Oregon would, and with sufficient water they can if they will, establish a record of 500 to 600 bushels per acre they probably could get five to ten times the present prices, selling seed to other states. (See O. A. C. Bulletin.)

Mr. George H. Brown (see page 24) says:

"The main thing in improvement of the quality of potatoes is in the selection of seed. I do not think that so-called 'inbreeding' counts for very much. Potatoes can be bred up as well as down, and if properly selected and grown will improve just as readily as they will deteriorate with wrong methods. Rotation of crops is of course essential, but I do not believe it necessary to change soils. The prime requisites for successful potato growing are: Seed, soil, location, and the man behind all three. It is worse than useless to attempt it on some soils, and if you cannot raise choice to fancy grades it is folly to face the competition. Quality is everything in the potato business. Buyers always are hunting it. It is the growing and marketing of indifferent grades that keeps down the price. Growing in small quantities hampers both ease of selling and price; it is best to raise at least a carload and so fill your own car with choice potatoes that the buyers can depend upon. There was only one year in the past twenty that potatoes have not paid me more than wheat would have on the same acreage. I raise for the seed market only and sold this year (January, 1914) at 1 cent and 1¼ cents per pound. Two cars of this lot went to Sacramento for seed. I pay a railroad rate, New Era to San Francisco, of 25 cents per cwt. I consider that 60 cents per bushel is the least price at which it is profitable to raise and sell seed potatoes. . . . A good crop should not contain more than 15 per

cent of culls. . . . It is well to remember that light deteriorates the food quality of potatoes, if you are raising for table use, though it does not damage them for seed purposes. Careful handling at all times is an important feature. If you are located too far from a railroad there is no profit in potatoes, no matter how many you raise nor how good they may be. . . .

W. I. Swank of Portland, a large buyer and shipper of potatoes in Portland, and manager of the Onion Growers' Union, on February 5, 1915, said:

"The principal part of potato buying is in the raising. . . . Buyers always are looking, year in and year out, for the finest grades of stock. An extra fancy grade calls for potatoes that are of medium size, say from 3½ to 6 inches long, of uniform girth, free from roughness or knots, clean and of good color. . . . In preparing for the market the very best practice is to use a new Calcutta sack—or a No. 1 second-hand one—holding 120 pounds as near as possible, with the mouth slightly open and showing nice potatoes. The first appearance is of great aid in making a sale. . . . In packing it is a very good plan to use a roll of old sacks upon which to jar the sack in filling it; this avoids the bruising sometimes caused by jarring against a hard substance. . . . Packing in crates probably would not pay for local or nearby markets. But in shipping for long distances, as to the Atlantic Coast, they are very desirable and should be used. The crate should hold 100 pounds net, and be of octagon shape to facilitate ventilation. Each crate should be weighed by itself to insure full measure. . . . In storing potatoes they should be handled carefully to avoid bruising, kept clean, free from frost, and the temperature kept at from 40 to 60 degrees Fahrenheit. For proper ventilation they should be piled not over 5 or 6 feet deep, and preferably in a concrete cellar with air spaces and wooden flooring and inside walls. A very good plan to insure proper ventilation is to construct square ventilators, 6x6 inches, spaced about 6 feet apart, running across the floor and from the floor to the ceiling. As to the best time of year to sell, it is necessary for growers to be of different minds, some selling direct from the field, some holding in storage. Broadly speaking, if you have a fancy grade it is well to sell in the Fall if the price is right; if the grade is inferior it is better to store. . . . The best market usually is in January, February and early March. . . . The demand for Early Rose seed is uncertain and limited to California . . . The Pacific Coast markets do not take to round potatoes, while Texas and the South like that shape. . . . Idaho and Washington ship a good many round potatoes and yet, even when the quality is the same, they bring 15 to 20 cents per bushel less, simply on account of the shape. . . . If irrigation is properly done, I do not think it makes any difference in the appearance or cooking qualities of the potato. Seattle considers the irrigated Yakima potato the very best. . . . I am a great advocate of deep plowing and thorough and repeated cultivation. . . . California sometimes takes half of its seed from Oregon, but about every third year, or when there are poor markets, they use their own. . . . There always is a considerable demand for seed of early varieties, but they demand a good quality, with uniform girth and inset eyes, and a smooth bright skin. . . . In Oregon we ship away our best potatoes and use what is left for both table and seed. We should select and keep our very best for seed if we are to improve the quality and quantity of our yield. . . . Oregon shipments to Alaska are small, though there is some demand for early varieties at good prices in August, if the quality is right. . . . We have no local market worth considering and must aim to ship in not less than carload lots if we are to meet competition successfully."

Prof. H. D. Scudder of O. A. C. in a recent talk said:

"Potatoes are a cash crop and for that reason one of the most valuable to the farmer. . . . One of the chief troubles has been that anyone has grown potatoes in any old way. . . . We need to improve the quality, especially for seed. At present it would be difficult to buy enough good and pure seed in Oregon to plant 500 acres. . . . The production in Oregon is six million bushels a year, the bulk of which is sold for table use, and only about 10 per cent for seed. Our greatest market with the largest possibilities is right at home in our own state. . . . Of the Oregon crop at present 25 to 35 per cent is culls."

George Hall, commission merchant of Eugene, says:

"The only requisite for Oregon farmers to make money from potatoes is to improve the quality and pack carefully. I have seen a thousand men get rich raising potatoes on rocky farms in New York state—because they established and maintained quality. When we establish the same reputation for potatoes that Hood River has for apples we can sell at a big premium. Government inspection of potatoes is far more important than for apples. If properly approached the railroads probably would be willing to grant reduced freight rates on seed potatoes, as is done in Germany. California has a rigid inspection law, especially against scab, and seed potatoes from there have sold in Eugene for as high as 2 and 3 cents a pound. We should be selling to them instead of the reverse."

The manager of the Southern Idaho Producers' Association says:

"Your growers never will make a success until they learn to do their own marketing cooperatively."

G. L. Huey of Michigan, writing in "The Rural New Yorker," says:

"My belief, which is backed by ten years of experiments and tests, is that hill selection of seed at digging time will increase the yield, give a more uniform size, eliminate the small tubers to a great extent, and improve the quality. Also that the planting of small stock, as is done by a great many (the undersized seconds left after the large ones have been taken up), will cause deterioration, for in almost any field you examine you will find a few hills that will not produce a single saleable tuber. . . . I do not condemn planting small tubers if they are produced from good, strong, thrifty hills. They will not deteriorate or run out, but are just as desirable for seed as larger tubers, for they are just a later setting and therefore good seed. It is poor economy in raising potatoes to sell all the best and plant the residue. After five years of hill selection of seed, I sold my entire crop each year, getting 5 and 10 cents above the market, the buyers using my potatoes to face cars with. I could always dispose of my load even when there was a shortage of cars or the market overstocked, and I never had a load run over the screen as sorts, which is practiced here. . . . Some years I have seen as many as 15 bushels of large tubers thrown out of a load of 60 or 75 bushels, then another year the same production of small ones, and all this can be eliminated by hill selection of seed."

The Oregon potato crop is practically all marketed at Portland, Seattle and San Francisco, all the Garnet Chile, Early Rose and other varieties raised as a seed crop being marketed in the last named city.

TABLE No. 12—*Following are the prices for ten years, on December 1, for Portland, Oregon, and for the United States:*

Year	Portland	U. S.	Year	Portland	U. S.
1900	45	43	1906	56	51
1901	70	47	1907	56	62
1902	55	47	1908	68	70
1903	50	51	1909	60	55
1904	59	45			
1905	60	62	Average	58.1	57.3

There are no figures available showing the amounts of potatoes exported to other states from Oregon, or to Oregon from other states. The Southern Pacific Railroad states that they shipped out of the state, over their main lines, between March 1, 1913, and March 31, 1914, 2,051 carloads; over their Spokane, Portland & Seattle lines, 3,723,223 pounds. The O.-W. R. & N. shipped from the state, from July, 1913, to April, 1914, both inclusive, 17,312 whole tons. The amounts of potatoes shipped from Portland by water were: 1910, 3,388 sacks; 1911, 12,073 sacks; 1912, 17,093 sacks; 1913, 12,990 sacks; 1914, 43,172 sacks.

COMPETITION FOR OREGON POTATOES

In addition to the foregoing, some of the competitive figures and conditions Oregon must face under the present situation are shown by the following table:

(*a*) TABLE No. 13.

Country or State	Average yield in bu. per acre 1912	Average yield in bu. per acre 1913	Average farm price received, cents per bu. Dec. 1, 1912.	Average farm price received, cents per bu. Dec. 1, 1913	Average cost of production per bu.
Germany	223	.....	Av. for 10 yrs. 23.67	....	....
Maine	198	220	55	53	30
Minnesota	135	110	28	52	30.3
Michigan	105	96	41	53	25.5
Idaho	185	170	29	50	25.5
Washington	167	123	36	60	19.3
California	130	119	65	70	44.4
Oregon	155	135	31	58	21.5
United States	113.4	90.4	50.5	68.7	21.2

From July 1, 1913, to May 1, 1914, Maine shipped 37,200 carloads out of that state, and there remained approximately 3,000 carloads to be disposed of. As a carload varies from 600 to 650 bushels, there were 24 to 25 million bushels sold out of the state, and probably seven million used within the state for seed, food and starch.

This, at an average price of 30 cents per bushel, would mean an income to the state from this source alone of $7,500,000 from other communities.

Approximate fricght rates from Idaho are: Per cwt. to Texas points, 55 to 73 cents; Missouri River, 45; Mississippi River, 50; Tennessee, 60; Chicago, 60; Arizona, 75; San Francisco, 40; Twin Falls to San Francisco, 66; Twin Falls to Portland, Oregon, 38.

Approximate rail freight rates per cwt. from Oregon are: Eastern Oregon to Texas, 65 cents; Willamette Valley to Texas, 75; Willamette Valley to San Francisco, 26½; Portland to San Francisco, 25; Redmond to Portland, 21; La Grande to Portland, 19¼.

Freight rates are another important item affecting competition. The ocean rate from Germany to New York, Galveston, New Orleans and other Atlantic seaports is $3.89 per ton. The rate from Portland, via the Panama Canal to the same points would be $6 per ton. From Willamette Valley points the freight to Portland by rail ranges from 8 to 15 cents per cwt.; from Portland to the Atlantic Coast, by water, 30c, which would give a rate of $8 a ton against Germany's $3.89—or more than double. The rail rate from Colorado to the Southwest is 70 cents per cwt., from Portland 75 cents. With potatoes at 60 cents per bushel it would cost Colorado $1.30 to lay them down in Galveston, for instance. Portland, via the Panama Canal, could deliver at the same point for $1. Idaho has a rail rate of 38 cents per cwt to Portland, which would make her potatoes, f. o. b. Galveston, $1.28 (on the same basis of 60 cents per bushel at shipping point). Eastern Oregon and Washington would be on about a par with Idaho. The Willamette Valley and Southwestern Oregon have an advantage over the Yakima district of about 10 cents. In all rail shipments the country east of the mountains, and especially Michigan and Minnesota, have an advantage in freight rates over Western Oregon, but the latter has the advantage, by reason of the Panama Canal, to Atlantic Coast cities.

(See O. A. C. Bulletin.)

George H. Brown says:

"When Willamette Valley Burbanks are selling for $1.60 a buhel, Salinas Burbanks bring as high as $2.10 for the same quality, because of the reputation that has been established by the latter and the close selection practiced. . . . Oregon's most serious rival in the potato business is Idaho. We really cannot compete with her on any large scale. She has deep soil that is ideal for potato culture and plenty of it, irrigation that gives her water when she wants it, and none

when she does not; she can grow alfalfa as we, as a state, cannot, and there is nothing better than alfalfa to prepare and restore potato soil; and she has the advantage in freight rates. All this makes the competition of Idaho a serious matter to the Oregon grower, but still nothing to be discouraged about if he will raise and keep up the quality of the Oregon potato. But don't go into the potato business—or any other, for that matter—unless you like it."

W. I. Swank says:

". . . To the Oregon grower the competition of Idaho is a very serious factor. . . . They have large tracts of excellent potato land and irrigation gives them a practical certainty of a good crop, irrespective of the weather. Not only can they put the water on when they want it, but they can keep it off at the proper time so that in digging the crop comes clean from the soil. Because of water regulation they have a heavier yield than we do as a rule. About the only advantage Oregon has over Idaho in natural conditions is that they are subject to heavy frosts occasionally. . . . Idaho also has freight advantages to the south and east in rail shipments. They can ship to Texas, for instance, at from 45 to 65 cents a cwt., which is 11 cents less than the Oregon rate, so they practically shut us out. They also can and do make heavy shipments to California and undersell Oregon. . . . Last season (1914) the Idaho crop was about 4,000 cars, against Oregon's 3,000. This season they probably will ship 5,000 to 6,000 cars, against our 2,000. . . . A large percentage of the Idaho crop is sold through associations, local and general, and this is by all odds the very best plan, especially when each grower puts his name on his sacks and so establishes a reputation. . . . The majority of the Alaska supply comes from Seattle and consists of early potatoes from the White River District. . . . A large percentage of Oregon potatoes are inferior, those from Idaho and Washington averaging much better quality."

(See preceding and succeeding chapters, this bulletin, and also Tables No. 1, 3 and 4. See reports on conditions in other Western states on preceding pages and chapter on "Possible Markets," page 27, as well as the following.)

COST OF PRODUCTION

The following table shows average costs of producing a bushel of potatoes—exclusive of rental or other value of land, and exclusive of transportation expense—in various countries, states and sections. Compiled from government reports, statements from state and country officials, and other sources. While these figures have been gathered with all possible care and are as accurate as may be, they cannot be relied upon absolutely in all cases, owing to the meagerness of the information available, and the wide fluctuations in cost of production, even in the same district. They are, however, approximately correct for the purpose of comparison one with the other. Note that these figures are averages and therefore indicate a higher cost than would be the case with experienced growers; for instance, the cost per bushel in Idaho, under good practice, is less than 20 cents, though the average of figures secured, as shown by the table, is 25.5.

(See O. A. C. Bulletin.)

TABLE No. 14.

Locality	*Cost per bu., cents*
Germany—	
Saxony, Province 5 year average	21.9
Mecklenburg, 5 year average	21.0
Silesia, 5 year average	17.4
Saxony, Kingdom, 5 year average	25.5
Belgium	19.7
Quebec, Canada	24.3
Ottawa, Canada	33.0
British Columbia	28.5
United States	21.2
North Atlantic States	25.3
South Atlantic States	23.6
North Central, east of Mississippi River	17.8
North Central, west of Mississippi River	20.0
South Central States	25.8
Far Western States	18.9
Maine	30.0
Vermont	40.2
New York	40.6
Virginia	44.5
Ohio	48.9
Florida	97.6
Alabama	77
Texas	76
Arizona	46.1
Kansas	35
Missouri	32.1
Minnesota	30.3
Michigan	25.5
North Dakota	31.7
Wisconsin	18.5
Colorado	44.9
Colorado (Greeley and Carbondale	26.0
Idaho	25.5
Washington	19.3
California	44.4
California, Lompoc Valley	21.5
Oregon	21.5
Coast	19.4
Willamette Valley	21.8
Eastern, irrigated	24.6

(There is a marked difference in wages: 39 to 49 cents, without board, in Germany as against $2.00 in the United States.)

TABLE No. 15. (*a*) *Detail of Cost of Producing Potatoes in the United States, for the Year 1909. Compiled as averages from estimates of over 4,000 correspondents of the Bureau of Statistics, United States Department of Agriculture.*

Item	United States	North Atlantic States	South Atlantic States	North Central East of Mississippi River	North Central West of Mississippi River	South Central States	Far Western States	Idaho	Washington	Oregon
Yield per acre, bushels	118	138	111	115	102	84	137	158	147	140
Value of land per acre	$64.20	$62.07	$44.76	$71.06	$68.25	$35.35	$74.23	$68.21	$89.15	$70.00
Commercial fertilizer	$ 3.29	$ 9.01	$ 5.62	$ 1.07	$ 0.40	$ 1.94	$ 0.46	$ 0.49	$ 0.98	$ 0.10
Preparing ground for seed	3.38	4.72	3.20	3.28	2.22	2.41	3.42	3.00	3.98	3.77
Seed	5.36	5.90	5.84	4.38	5.44	6.49	5.70	5.52	4.49	4.20
Planting	2.39	2.58	2.46	2.10	2.44	2.12	2.84	3.05	3.12	2.80
Cultivating	3.15	3.83	3.20	2.96	2.44	2.88	3.73	3.71	4.32	4.60
Gathering	5.77	6.73	4.41	5.28	5.64	4.25	7.02	7.99	7.49	7.10
Rental value of land	3.99	3.85	3.87	4.15	3.66	3.84	4.87	4.45	5.00	4.75
Other items of cost	1.71	2.20	1.50	1.37	1.26	1.60	2.76	3.41	3.86	1.98
Total cost, including rental value of land	$29.04	$38.82	$30.10	$24.59	$23.50	$25.53	$30.80	$31.62	$33.24	$29.30
Total cost, excluding rental value	25.05	34.97	26.23	20.44	19.84	21.69	25.93	27.17	28.24	24.55
Cost per bushel, including rental value	Cents 24.6	Cents 28.1	Cents 27.1	Cents 21.4	Cents 23.0	Cents 30.4	Cents 22.5	Cents 20.0	Cents 22.6	Cents 20.9
Cost per bushel, excluding rental value	21.2	25.3	23.6	17.8	20.0	25.8	18.9	17.2	19.2	17.5
Value of product per bushel	53	53	60	46	53	71	64	55	55	55

These figures vary slightly from other reports.

The following, supplied June 2, 1914, by Joseph Begin, Superintendent of the Experimental Station of the Federal Ministry of Agriculture, of Quebec, Canada, is given, not only for the value of the figures themselves, but also as an example of thorough cost keeping that might well be followed by every grower of potatoes:

TABLE No. 16—*Cost of Producing Potatoes, according to data from the best practical growers in this district for the past three years.*

Rent of land	$ 4.00
Cost of 10 pounds clover, at 24 cents	2.40
Barnyard manure, 18 tons at $1.00 (⅓ exhausted in 1 year)	6.00
Commercial fertilizer, 300 pounds at $20 (⅓ exhausted in 1 year)	2.90
Plowing of land in spring	2.50
Disc harrowing twice	.80
Harrowing once with a smoothing harrow	.20
Drilling, 2½ hours, at 30 cents per hour	.75
Seed, 25 bushels, at 50 cents	12.50
Cutting seed, one day	1.60
Planting seed, one day	1.60
Covering, 1¼ hours, at 40 cents	.50
Harrowing twice with a smoothing harrow	.40
Cultivating six times, 15 hours, at 30 cents	4.50
Hoeing once, one day	1.60
Poison, Paris green	1.50
Bluestone, 50 pounds, at 10 cents	5.00
Spraying with poison three times with horses	2.40
Spraying with Bordeaux	2.40
Digging, three hours, at 40 cents	1.20
Picking up potatoes, 2½ days at $1.60	4.00
Storing, 4 loads, 4 hours, at 40 cents	1.60
Sorting and marketing, 1 man, 4 days, at $1.60	6.40
Team, 2 days, at 24 cents per hour	4.80
Team, 2 days, at 24 cents per hour	4.80
Wear and tear on machinery and interest on money	1.25
Total	$72.80
Average cost of production, per bushel	.243
Average farm price received, per bushel	.40

The above data is for a 300 bushels per acre crop, which is considered the best average crop obtained on the best farms in this part of the country. However, this is about 25 per cent over the general yield of potatoes on the whole.

Mr. George H. Brown of New Era, Oregon, one of the best and most successful growers of potatoes in the state, with over twenty years experience in raising and marketing this crop, gives the following as his average cost of production per acre, exclusive of rental value of land, and basing it on wages of $2 per day for a man and $4 per day for man and team. Average yield 150 bushels per acre.

TABLE No. 17.

Land plaster (gypsum), 50 pounds	$ 0.25
Plowing, twice	3.00
Harrowing, five times	1.25
Disking, twice	.80
Cultivating, five times	3.75
Seed, 10 bushels	5.00
Seed, cutting	.50
Seed, planting	1.00
Digging	1.00
Picking up	3.00
Sacks, 60	3.60
Sorting and sacking, at 10 cents per sack	6.00
Total cost of production of 150 bushels	$29.15
Cost per bushel	.194

As Mr. Brown's farm and warehouse are located directly upon the railroad his cost of loading on cars runs from a half to one cent per sack. For an ordinary haul about 5 cents per sack would have to be added. Mr. Brown sells almost exclusively for seed and states his average profit to be $40 to $50 an acre.

Howard Dalton, of Willard City, Utah, has earned the title of "Boy Champion Potato Grower." On one-half acre he raised 360 bushels, which he sold for

$187.77, or 52 cents a bushel. The cost of growing was: Value of manure, $2; spreading manure, $4; plowing, $1; harrowing, six times, $1.50; leveling, $1; cost of seed, 450 pounds, $5.20; planting seed, $2; cultivating, two times, $1; irrigating, three times, $1.50; weeding, once, $1.50; harvesting, $18; rent on land, $8. Total cost, $46.70. A net profit of $141.07.

H. H. Weatherspoon, district commissioner of the State Board of Horticulture, at Elgin, Oregon, gives the following cost items for a production of 75 sacks per acre on land valued at $50 per acre:

TABLE No. 18.

Plowing, planting, cultivating, cents per cwt.	$ 0.21
Digging and picking	.10
Sacks, each	.08
Cost of actual production	.39
Delivery on cars	.05
Freight to San Francisco	.35
Profit to farmer, 5 per cent on his investment	.10
Total	$ 0.89
Average actual cost, per bushel	.234

"This is very close figuring and about an average for Oregon, and means a cost of $71.10 an acre to produce 150 bushels or 9,000 pounds. Prices lower than this will put all Eastern Oregon and Southern Idaho out of business, as they would be compelled to irrigate. These figures can be relied on for all territory east of the Blue Mountain Range."

The following figures of detailed cost of production may be compared with Table No. 18:

TABLE No. 19—*Statement by Dairy Inspector, Augusta, Maine, May 20, 1914, of average cost of production in that section.*

Average yield per acre, 285 bushels; average value of land per acre, $50 to $150.

Commercial fertilizer	$30.00
Applying fertilizer	2.00
Plowing	2.85
Harrowing	4.00
Seed, 14 bushels, at 80 cents per bushel	11.20
Cutting and planting	5.75
Cultivating	7.00
Spraying	5.75
Harvesting	14.00
Grading and sacking	12.00
Total cost, excluding land value or rental	$94.55
Cost per bushel, excluding land value	.331

E. H. Grubb (i) is authority for the following Idaho figures:

TABLE No. 20.

Average yield per acre, 150 bushels; average value of land, about $125.00.

Plowing	$ 3.00
Harrowing	.75
Floating	1.00
Seed, average 700 pounds, at 2 cents per pound	14.00
Planting	2.50
Irrigating, first year	5.00
Cultivating, 3 times at 50 cents each	1.50
Digging	1.50
Picking, at 4 cents per bushel	6.00
Sacks, 75 at 7 cents each	5.25
Hauling to pit	2.00
Total, excluding land or rental value, interest, taxes or other overhead expenses	$44.00
Cost per bushel, exclusive as above	.293

TABLE No. 21—*The Manager Southern Idaho Producers' Association, under date of June 6, 1914, gives the cost there as:*

Average yield per acre, 150 bushels.

Breaking alfalfa land, fall plowing	$ 4.00
Breaking alfalfa land, spring plowing	2.15
Harrowing, 3 times	.20
Seed, 1 to 1½ tons per acre, at 50 cents per bushel	25.00
Cutting	.75
Planting	2.50
Fertilizing	.20
Harrowing after planting	.40
Five times over with cultivator	10.00
Digging	3.00
Picking up, 5 cents per cwt.	4.50
Sacks, 6 cents per cwt.	5.40
Hauling to train, 50 cents per ton	.75
Total	$58.85
Cost per bushel	.392

(Note that in the above the fertilizing cost is only for spreading, and does not include value of fertilizer itself. Also that 150 bushels per acre is a low estimate, it being nearer 200 bushels usually. At the latter figure the average cost per bushel would be 29.2 cents. The state average for cost per bushel, compiled from a number of statements, is 25.5 cents, while some producers claim as low as 17 cents.)

TABLE No. 22—*L. F. Shanklin of Lompoc, California, gives cost for that district as:*

Average yield per acre, 260 bushels.

Rental of land	$30.00
Seed, 400 pounds, at 1½ cents per pound	6.00
Plowing and preparation	5.00
Cultivating twice, hoeing once	1.00
Digging and picking	3.00
Sacks, 5 cents each, and sacking 5 cents	10.00
Hauling	1.00
Total, including land value	$56.00
Average cost per bushel, including land value	.215
Total, excluding land value	26.00
Average cost per bushel, excluding land value	.10

(Even if the above production per acre were cut in half, it would give an average cost per bushel of only 20 cents, or about the same as Oregon.)

DeWitt C. Poole, Jr., Deputy Consul General, Berlin, Germany, June 9, 1914, gives the following average costs for the five years, 1908-13, which are exclusive of land values or interest:

(*a*) TABLE No. 24.—*Wholesale Prices in Cities, December 12, 1914.*

Locality	Planting and cultivation	Harvesting	Cost per acre	Cost per bushel
Province of Saxony	$11.14	$ 7.79	$18.93	$0.219
Mecklenburg	8.32	10.30	18.62	.21
Silesia	10.42	7.17	17.59	.174
Kingdom of Saxony	6.96	6.28	13.24	.255

MARKET PRICES

(*a*) TABLE No. 24—*Wholesale Prices in Cities, December 12, 1914.*

City	*Cents per bu.*
Pittsburg	43 to 50
Dallas	80 to 85
Denver	90 to 115
St. Louis	38 to 52
Cincinnati	40 to 48
Chicago	30 to 43
New York	42 to 67
Kansas City	40 to 56
Detroit	100 to 105
Minneapolis	45 to 50
Cleveland	33 to 45
Jacksonville	92 to 100
Philadelphia	42 to 62

San Francisco—	*Per cwt.*
Delta Burbanks	75 to 100
Salinas	135 to 150
Oregon	100 to 125
Los Angeles, Burbanks	115 to 140
Los Angeles, Idaho Rurals	105 to 120
Portland	65 to 75
	Per ton
Seattle	$13 to $17

TABLE No. 25. *Prices Paid for Potatoes to Producers in Oregon. (Cents per bushel of 60 pounds.)*

Date	1911	1912	1913	1914	Average
January	73	61	31	53	54½
February	71	65	32	55	56
March	80	78	35	50	61
April	83	102	36	43	66
May	98	88	20	37	61
June	137	75	22	40	68½
July	154	75	29	....	86
August	120	65	60	....	82
September	84	50	55	....	63
October	76	38	58	....	57
November	64	36	52	....	51
December	67	31	58	....	52
Average	92	64	40	....	64

TABLE No. 26. *Prices to Producers.*

	May 1, 1913	May 1, 1914	December 1, 1912	December 1, 1913
Idaho	$0.30	$0.48	$0.29	$0.50
Washington	.32	.42	.36	.60
Oregon	.20	.37	.31	.58
California	.42	.65	.65	.70
United States	.48⅕	.714	....	....

California: Prices to producer, in cents per bushel: 1908, 77; 1910, 85; 1911, 90; 1912, 65.

Idaho: First shipments bring about 50 cents per cwt. The average net prices to growers, by months, is: September, $1; October 75 cents; November, 77 cents; December, 67 cents; January, 90 cents; February, 75 cents; March, 63 cents; April, 70 cents; May, 80 cents per bushel. In November, 1914, potatoes were selling at 30 cents per bushel, f. o. b. shipping points.

(j) The average price on New York farms for 47 years—1866 to 1912—was 53 cents per bushel; and the average wholesale price in cities—1850 to 1913—was 65 cents.

POSSIBLE MARKETS FOR OREGON POTATOES

It is stated that plans are being matured for shipping to the Atlantic Coast via the Panama Canal from Portland, and that a market there can be created.

The Department of Commerce, New Orleans, reports:

"Oregon potatoes reach Louisiana only when Michigan, Wisconsin and Minnesota are exceptionally high in price, the latter being most favored and being sold to commission merchants, laid down in New Orleans, at $1.50 per cwt. Washington and Colorado potatoes bring $1.45 cwt., f. o. b. New Orleans. The freight from Oregon is prohibitive except under unusual conditions." (This before Panama Canal, through which rate may be provided at 30 cents cwt.)

E. E. Judd, the Department of Commerce agent at New Orleans, reports, January 28, 1915:

"Some of the principal potato dealers in this city inform me that in the past Bermuda potatoes have come into the New Orleans market for about two weeks in April of each year, but that during the past two years no shipments have been made. They state that Bermuda supplies a new early potato that sells at about $5 per barrel, and enters the market between the seasons of domestic potatoes. The production of early potatoes in this immediate vicinity has increased so rapidly that within the last two years the Bermuda article has been practically driven out of this market. . . . The home grown potatoes come on the market in April and last until about the middle of July. From then until about the first of December supplies are obtained from Oklahoma, and after that from

Wisconsin and Michigan. The latter cost about 60 cents per bushel, sacked, laid down in New Orleans. These potatoes pay a rate of 42½ cents per cwt., or about 30 cents per bushel. They are of excellent quality and fill the market needs satisfactorily. Oregon potatoes come into this market by rail, though the rate is 75 cents per cwt. This only has occurred when the Western potatoes come very cheap and those of Michigan and Wisconsin are high in price. Mr. Kohlman, of Kohlman Bros. & Sugarman, who are among the largest dealers in potatoes in this city, is rather skeptical as to the success of shipping Oregon potatoes into this port by water (via the Panama Canal). He says that early potatoes would be likely to spoil en route, and very late potatoes would be likely to sprout. He believes that shipments of sound matured potatoes might come through satisfactorily, but that such potatoes would reach his market at the height of the season, when prices would be low. He would, however, be glad to get in touch with possible shippers who would be willing to quote a price laid down in New Orleans for sound potatoes, the shipper taking all the risks of spoiling en route. . . . I would be glad to supply the names of other commission merchants in this city if so desired."

One of the features of the New York City market is the high prices commanded—an average of $1.44 per bushel ($6 per barrel)—by the Bermuda potatoes. (Compare this with Oregon's average of 58 cents—more than double.) The freight rate, by water, from Bermuda to New York is 50 cents per barrel. The first shipment arrives in New York about December 1, and consists of the second crop grown in Bermuda. The next crop begins to arrive in April and the first of May. The stock received during the winter months is known as the fall grown crop and is a red-skinned round potato. The spring crop consists largely of the Bliss-Triumph variety. Shipment is made in barrels. These Bermuda potatoes command a special price because of their high quality for table use, none of them being imported for seed, and also because they mature very early in the spring, or in the latter part of our winter, and so reach the market when prices are highest and domestic supply lowest. (See Table No. 3.)

Brazil needs and imports large quantities of potatoes. Before the war most of her supply came from France—now they must come from other countries. Experimental shipments from Oregon to Brazil and other South American countries might lead the way to the establishment of a regular and profitable market with that country. Present prices (October, 1914) are $1.45 to $1.60 per case of 66 pounds, including cost, insurance and freight to Santos. Each box must contain 66 pounds, and great care must be taken in packing. Wooden cases, as light as possible to stand the rough handling of ocean freight should be used, and they should be securely strapped with wooden staves or steel wire. The planks must be wide enough apart to permit thorough ventilation. (See pages 15-19.)

THE INDUSTRIAL USE OF POTATOES

In the industrial utilization of potatoes, manufacturing commercial starch, glucose, dextrine, alcohol, flour, stockfood, etc., it is the starch content of the tuber that determines its value as it is from the potato-starch in its natural state that the various products are made, or upon which their food value depends.

(f) The quantity of starch contained in potatoes is, as a rule, 10 to 20 per cent. It is greatly influenced by the method of keeping them, as the life of the tuber and consequently also the process of decomposition continues until the potato is used. It is probable that an increase of starch may be obtained by drying out the potatoes. Stored potatoes never should be exposed to frost. When stored for any length of time their content of starch decreases, especially if they be stored in damp or warm bins. Sprouting also decreases the content of starch.

(f) Potatoes raised in Germany for industrial purposes are marketed for at least one-third less than table potatoes and the highest prices paid (36 cents) for either variety during ten years is nearly 10 cents less per bushel than the prices described by the Secretary of Agriculture as low in the United States. Under these circumstances there would appear to be no great encouragement for the building of stills and starch and drying plants for the utilization of potatoes

exclusively in the United States on a scale comparable with that in Germany until some change in agricultural conditions gives the manufacturer a cheaper raw material.

(n) "The reasons for the comparatively small industrial use of potatoes in the United States may be summed up as: Same products can be made cheaper from other materials; price of potatoes for other purposes too high; not sufficient supply of culls and surplus available to factories; value of stockfood; foreign competition, Germany paying an average of only 18.3 cents per bushel for industrial potatoes. Corn, for instance, can be produced more economically, is better for stock feeding, and is a cheaper source of starch, glucose and alcohol. The scarcity and high cost of labor in the United States are other factors of influence."

"In every 100 pounds of average potatoes there is 75 pounds of water; of the remaining 25 pounds, about 20 is carbohydrates (starch and sugar, etc.), and 2 pounds protein. . . . Tests made in 1899 of 46 different varieties showed the Zenith variety to possess the highest starch content—22.9 per cent; and Royal Blush the least—13.1 per cent; the average for all varieties being 16.2 per cent. In 1890, 31 varieties, mostly different from those tested the previous year, had an average of 14.3 per cent, Burbank showing the highest with 17.7 per cent; and the Kidney the least—11.4 per cent. All were grown on the same kind of soil and under practically the same cultural conditions. Still, the variations in starch content was as much as 9.8 per cent. The percentage of starch in pronged tubers was smaller than in the regular. . . . The percentage was largest in the deeper growing tubers and smallest in those growing nearest the surface. . . . This would seem to be due to the temperature, the cooler the soil the greater the starch content. . . . Scabby potatoes are not necessarily poorer in starch than healthy ones."

POTATO STARCH

(f) The manufacture of starch from potatoes simply consists in the mechanical separation of starch from the other parts of the tuber. These parts must be opened and disintegrated and the starch washed out. (See O. A. C. Bulletin.)

(n) The manufacture of starch from potatoes in this country is at present confined to culls. . . . The margin of profit is not large, in spite of a protective tariff of 1 cent a pound; the factories are able to run only six weeks in the year, and the interest and overhead charges are therefore high.

(f) The total quantity of starch made in the United States in 1900 was 543,040,139 pounds, valued at $10,888,853; in 1905 the total was 358,005,026 pounds, valued at $10,975,597. . . . The value of the corn starch made by the 131 factories primarily engaged in the manufacture of starch in 1905 was $4,702,309, or 58.2 per cent of the total; the value of the potato starch was $924,476, or 12.9 per cent; of cassava and wheat starch, $1,124,612, or 12.4 per cent; and of cattle food, $508,723, or 6.3 per cent; the value of all other products, which include gluten feeds, corn oil, soap, etc., was $822,784, or 10.2 per cent of the total. . . . The decrease in the output in 1905 from 1900 was due in a large measure to the decrease in the foreign demand for starch. . . . There was a net decrease in 1905 of 14 in the number of corn starch factories, and a net loss in product of 86,554,660 pounds, or nearly 50 per cent of the decrease in the total output.

(f) "In the United States starch is principally made from corn. In 1909 about 40,000,000 56-pound bushels of corn were used for this purpose, as compared with some 3,500,000 60-pound bushels of potatoes. The corn starch was valued at $15,962,916, and totaled 638,825,366 pounds; the output of potato starch was 24,873,415 pounds, valued at $823,019. Glucose and glucose sirups to the value of nearly $18,000,000 were manufactured in 1909, but the principal raw material used was corn. The potato starch industry in the United States is centered in Arrostook County, Maine, where in 1909 there were 61 of the 64 factories in the state. These factories reported the consumption of 2,854,729 bushels of potatoes, or over 80 per cent of the total used in the country for the manufacture of starch.

(g) The starch factories making potato starch produced 27,709,400 pounds in 1905, or 14.1 per cent of the total produced by the 131 factories making the manufacture of starch a specialty. This output of potato starch was 6,232,426 pounds, or 18.4 per cent less than that of 1900. No potato starch was made in 1905 in New Hampshire and North Dakota, although it was produced in 1900, while the decrease in Minnesota was large. . . . The exports of starch from the United States was 124,935,963 pounds in 1900, valued at $2,604,362; and 61,450,444 pounds in 1905, valued at $1,430,572. This shows a loss in the five years of 50.8 per cent, and was caused by the large increase in the manufacture of potato starch in Europe, particularly in Germany and Russia.

TABLE No. 27. *(g) Quantity and Value of Potato Starch Produced by United States, 1905 and 1900. And Quantity and Value of Potatoes Used, and Starch Produced in 1905. *Michigan only.*

State	Census	Starch produced		Potatoes used	
		Pounds	Value	Pounds	Cost
United States	1905	27,709,400	$ 924,476	209,372,549	$ 563,651
	1900	33,941,826	1,129,129	.....	.....
Maine	1905	15,454,787	523,200	105,694,521	331,250
	1900	15,273,633	544,760	.....	.....
Minnesota	1905	6,627,638	221,355	60,167,770	130,583
	1900	10,882,333	329,566	.....	.....
New York	1905	650,517	23,379	5,272,200	11,645
	1900	265,000	8,935	.....	.....
Wisconsin	1905	4,925,858	154,797	37,747,978	88,980
	1900	5,043,060	154,030	.....	.....
All other states	1905	50,600	1,745	*$490,080	*1,193
	1900	2,477,800	91,838	.....	.....

The average price per pound for potato starch, according to Table No. 23, is shown to have been 3.33 cents. Note that the amounts received for the manufactured starch was, roughly, a little less than twice as much as the cost of the potatoes used.

(d) The United States exports and imports of starch, 1911, 1912 and 1913, were as follows; the varieties of the imports are not specified, while the exports probably were all corn starch:

TABLE No. 28.

Year	Imports		Exports	
	Pounds	Value	Pounds	Value
1911	7,938,730	$ 222,470	158,239,178	$ 3,137,552
1912	15,841,437	478,465	83,644,749	1,965,401
1913	16,710,498	457,784	110,897,591	2,609,716

The import duty on starch made from potatoes is 1 cent per pound; on all other starch or starch substances, ½ cent per pound.

For information of value in regard to the manufacture of starch from potatoes we again must turn to Germany, where the industry has been brought to a high state of perfection, and where more is made than in all the rest of the world put together. The following should be taken in connection with the remarks on production in Germany, in this bulletin.

(f) The importance of the German starch-sugar industry is set forth in imperial statistics as follows:

TABLE No. 29. *Quantities of Starch Manufactured into "Sugar"*

Fiscal years	Factories	Produced in establishments		Purchased		Solid "sugar" produced
		Wet	Dry	Wet	Dry	
		Tons	Tons	Tons	Tons	Tons
1906-7	25	48,792	370	42,461	3,989	10,064
1907-8	24	43,279	340	46,886	1,515	9,862
1908-9	24	51,107	541	42,289	3,861	8,762
1909-10	24	77,085	678	42,844	678	8,184
1910-11	24	76,021	479	45,522	2,560	8,811

(k) Estimate of number of establishments in Germany making starch, glucose, etc., quantity of potatoes used therein, and amount of starchy materials produced in years 1899-1902, year ending September 30:

TABLE No. 30.

Year	Factories number	Quantity consumed. Bushels	Materials produced. Tons
1899	578	33,333,333	250,000
1900	590	40,300,000	274,750
1901	595	44,000,000	300,000
1902	627	51,000,000	349,000

(i) One German factory uses 250,000 tons of potatoes annually. The price paid for potatoes of 18 to 24 per cent starch content is 20 to 35 cents per 100 pounds, or 12 to 21 cents per bushel. One of the by-products is 3,500 tons of glucose.

(f) Export from Germany to the United States:

TABLE No. 31. (*f*) *Export from Germany to United States.*

	Potato starch	Dextrine, etc.
1910	3,301 tons	2,297 tons
1911	2,163 tons	1,609 tons
1912	1,002 tons	1,281 tons

"By scientific improvement of varieties of potatoes the starch contents were increased from 14 per cent in 1875 to 20 per cent in 1905, and often reached 28 per cent."

But the above is contradicted by individual district tests, which show an average of 15 to 18 per cent.

"In Germany potatoes particularly rich in starch are grown especially for the starch industry."

(For details of potato-starch industry in Germany see Special Consular Report No. 64, Department of Commerce and Labor.)

With regard to the feasibility and advisability of establishing a potato-starch factory on the Pacific Coast, and, more especially in Oregon, the following statements are made:

(h, greatly condensed) The principal use of potato starch in the textile industries for the sizing and finishing of goods and the printing of calicoes, etc. . . . and is much more desirable for these purposes than corn starch. The average price for corn glucose on the Pacific Coast is about $2.75 per cwt., and for potato glucose 50 to 100 per cent more. Freight on corn glucose, Chicago to Pacific Coast, is 81 cents per cwt. . . . Any market other than a local household consumption would be found on the Atlantic seaboard. . . . The local consumption of glucose on the Pacific Coast is over 13,000 tons per annum, Chicago being the principal and nearest point of supply. Analyses of the starch contents of Oregon potatoes, the average of a large number of tests of different varieties, give 19.4 per cent; of California potatoes an average of 15.2 per cent. Assuming that 100 pounds of potatoes will yield 16 pounds of starch or glucose, the cost of manufacture would be 8 cents, the product, at 2.8 cents per pound,

would be worth 44 cents, leaving a net value of 36 cents to cover the cost of the raw material delivered at the plant. . . . The average crop yields 15 per cent culls. . . . Methods of production of starch in the United States are crude and not to be compared to German methods. Probably the United States recovers only about 60 per cent of the available starch contents, while most approved methods will yield approximately 95 per cent of commercially dry starch (16 to 18 per cent water). According to this 6 tons of 18 per cent potatoes, or 7 tons of 15 per cent, would yield 1 ton of commercial starch. . . . The prevailing price for potato starch in New York and Boston is 3 to 4 cents per pound. . . . If cost of manufacture is ¼ cent per pound, rail freight ½ cent and price received 4 cents, value of starch at point of manufacture is 3¼ cents. This would make 100 pounds of 18 per cent potatoes worth 60 cents, and of 16 per cent worth 52 cents. . . . For a plant with a capacity of 5 tons of potatoes per hour the cost of machinery (German) would be $20,000. . . . and total cost of a plant to manufacture 20 tons of starch or glucose per day of 24 hours would be, exclusive of site, $60,000. . . . Such a plant could reasonably handle 15 to 20 thousand tons of potatoes per season, of six months run, and make about 3,000 tons of starch. . . . This, at a value of 3¼ cents per pound, would total $195,000. . . . This means that 54 cents per cwt. could be paid for potatoes, without profit. Any price paid below 54 cents would indicate the profit.

(Note that corn starch is worth 1.78 cents per pound, delivered in Boston, as shown in letter on page 24, and potato starch 1½ times that, or 2.67 cents.)

Eustace Pennock & Co., Boston, who sell seven-eighths of all the potato starch manufactured in the United States, say:

They import half their supply. Starch is delivered to cotton mills at 3¼ to 3⅜ cents per pound; foreign can be landed in Boston at 3 to 3¼ cents per pound. Maine pays, at factories, for culls, 25 to 40 or 50 cents per barrel, containing 2¾ bushels, or 15 to 30 cents per cwt. Suggest state bounty of at least ½ cent per pound; North Dakota pays bounty of 1 cent per pound. Bounty probably would pay freight from Pacific to Atlantic Coast.

C. E. Brown, a grower of 20 years at Elk River, Minnesota, says, August 1, 1914:

"We have starch factories, but they run only to use culls, and when there is an overproduction, which is not very often. When potatoes are worth over 25 cents per bushel they cannot use them for starch."

Factory at Cambridge, Minnesota, reports September, 1913:

"We operate only about two months a year, when price is 20 to 35 cents per cwt. Pay dividends of 50 to 100 per cent."

Factory at Princeton, Minnesota, reports September, 1913:

"Operate about once in three years, last in 1909. Maximum price for potatoes 18 cents per cwt. No dividends.

Factory at Ishanti, Minnesota, reports September, 1913:

"Operate 40 days a year, pay 20 or 30 cents per cwt. for potatoes. Not paying proposition except as dump for culls and surplus. Get 6½ to 8½ pounds of starch from 60-pound bushel of potatoes. Starch sells at 2¾ to 4 cents per pound in local market. Takes ½ to ¾ ton of good soft coal, one man one day, to make ton of starch. Factory capacity of 6 to 8 tons per day costs $15,000 to $20,000. No money in potato starch business at present time."

Dairy inspector at Augusta, Maine, says:

"Potatoes for starch are worth 15 to 30 cents per bushel. Use culls only. Value in potatoes not sufficiently large to warrant shipment for any considerable distance from factory. Alcohol from potatoes not being made in Maine."

S. J. Mealey of Monticello, Minnesota, says, July, 1914:

"I am today junking all five of my starch factories that cost me from $12,000 to $18,000 per mill; because I cannot afford to pay over 18 to 25 cents per bushel and farmers are too prosperous to raise potatoes for that. This is based on a 25-cent lake and rail, and 30-cent all-rail freight to Boston and New England. Because of the competition of sago and tapioca and corn starch. The corn starch interests are spending thousands of dollars to perfect cotton machinery for the use of corn starch."

(The Utica Steam and Mohawk Valley Cotton Mills of Utica, New York, February, 1913, say:

"We have some times used potato starch in the manufacture of cotton goods, but at present we are using almost exclusively corn starch, for the reason that potato starch costs more than double the price of corn starch. We use six to ten carloads of starch yearly in our weaving mills. At the present time the price of high-grade Pearl corn starch, for warp-sizing purposes, is $1.78 per hundred pounds, delivered in Utica, in bags weighing 280 pounds each. The price in barrels is about 10 cents per 100 pounds more. When the price of potato starch gets down to, say 1½ times the cost of corn starch we would then use potato starch instead. For the past four or five years potato starch has been bringing fancy prices, as high as 4½ to 5 cents per pound."

George Hall of Eugene, Oregon, who was in the starch business for a number of years, says: "Oregon is too distant from the markets to make the manufacture of potato starch profitable under present conditions. A starch factory is not necessarily an expensive proposition; it should not cost over $8,000 for a modern plant of small size. Several small factories, built as inexpensively as possible, would be better than one large one, in order to reduce transportation charges as much as possible. It is doubtful if 'green starch' wet, as it comes from the crusher, could be shipped regularly and successfully. It sours very quickly in warm weather. Small 'green starch' factories shipping to a central dryer are impracticable and unnecessary; drying is a simple process. (See O. A. C. Bulletin.) Starch requires cool weather and an abundance of water to manufacture. The market price for potato starch is controlled by the price of corn starch; 1½ times the latter is the rule. It is not practicable to pay over 25 cents per bushel for potatoes. That is the maximum. In New York we figured to get nine pounds of starch from each bushel of potatoes, using culls and surplus. We received 3 to 4½ cents per pound for potato starch. If any factory offers to pay even as much as 30 cents per cwt. for starch potatoes they should be required to give a bond for payment of that price for a term of years if farmers are to plant expecting that payment. Payment should be made according to the starch content of the potatoes."

G. L. Tarbell of Yankton, Oregon, and C. True of Sherwood, Oregon, both formerly of Maine, where they raised thousands of bushels of potatoes for the starch factories there, unite in stating that 25 cents is the maximum that can be paid per bushel for that purpose, f. o. b. factory. . . . That the cost of production of potatoes in Maine is 12 to 15 cents per bushel. . . . It is impracticable and unnecessary to ship green starch to a central drying plant, since, when the green starch is made most of the work is done, and it costs little more to dry it; because it is of the consistency of soft soap and therefore not easy to handle; and because it is very apt to spoil in transit. . . . It is much better to build a number of small factories, costing about $8,000 each, and locate them close to the sources of potato supply and where water is abundant, rather than to build one large plant. . . . Starch making is a simple mechanical process for which crude machinery and the simplest type of buildings are entirely sufficient."

If, as is claimed, the districts on the coast of Oregon produce as high as 500 to 600 bushels per acre, then that is the section where a starch factory should be located, if the industry is undertaken in this State, and not where rail shipments would be necessary.

ALCOHOL FROM POTATOES

(i) Potatoes have a higher percentage of alcohol than other root crops, giving 14 to 26 per cent of fermentable matter to the cwt.; 20 per cent reasonably may be expected. (t) It has been shown theoretically, that 50 gallons of 95 per cent alcohol should be produced from the residues of 100 bushels of potatoes.

(r) Approximately 10 pounds of industrial alcohol can be made from 100 pounds of potatoes, or 6 pounds to the bushel. It has been shown that, at the prices quoted in 1905, the amount of Indian corn necessary for the production of a gallon of industrial alcohol costs not less than 15 cents. From this it is evident that the potatoes for alcohol making will have to be produced at a cost not to exceed 15 cents a bushel before they can compete with Indian corn.

(n) The manufacture of alcohol from potatoes has not yet become established in the United States, for various reasons. The prices of potatoes marketable for other purposes have been too high, and no sufficient supply of culls and surplus have been available. The average price for potatoes for distilling in Germany for five years, 1906 to 1910, was 18.3 cents per bushel. It is probable that the farmers there would be less disposed to grow the crop if it were not for its indirect benefits, including the feeding of the mash left over. Petroleum, which Germany lacks, provides us with fuel oil and gasoline at prices which at present nearly eliminate alcohol as a competitor.

(f) For the manufacture of alcohol the content of sugar in potatoes is as important a consideration as the content of starch. Their value for distilling increases with their ripeness. If they deteriorate in a dry state they still are fit for the manufacture of alcohol.

(For details of manufacture of alcohol and process used, see Special Report No. 64, Department of Commerce.)

(For regulations governing the manufacture of alcohol, pure and denatured, in the United States, prospective distillers should write to the Treasury Department, Washington, D. C. By conforming to certain restrictions of manufacture and sale, denatured alcohol may be made and sold free of tax.)

(k) Number of potato distilleries, quantities consumed, and alcohol produced therefrom in Germany, 1899 to 1902, year ending September 30:

TABLE No. 32.

Year	Distilleries. Number	Quantity consumed. Bushels	Alcohol produced. Gallons
1899	5,571	94,820,000	82,070,592
1900	6,332	91,740,000	77,877,078
1901	5,853	102,300,000	87,249,539
1902	6,537	113,266,666	92,965,940

(f) There were 5,577 farm stills and 17 industrial stills in operation in Germany in 1911, used principally for the extraction of alcohol from potatoes, against 7,626 farm stills and 710 industrial stills used principally for the extraction of alcohol from grain. The quantities of potatoes consumed and the alcohol produced in this manner in recent years are shown by the following table:

TABLE No. 33.

Year beginning October 1	Potatoes manufactured. (Metric tons)	Alcohol produced	
		Agricultural stills. (Gallons)	Industrial stills. (Gallons)
1906	2,632,000	78,179,270	265,887
1907	2,778,000	82,384,312	787,466
1908	2,939,000	89,625,882	698 889
1909	2,540,000	77,188,009	438,549
1910	2,519,000	73,570,841	565,509

(A metric ton is 2,204.6 pounds.)

(l) "For the year 1906-07, 5,871 agricultural distilleries in Germany produced 78,179,270 gallons of alcohol from potatoes, and 21 industrial distilleries 265,887 gallons. This was 77.3 per cent of the alcohol manufactured from all sources, which was 101,473,345 gallons. Of this total the percentages were: Potatoes, 77.3 per cent; grain, 7.2 per cent; grain yeast, 12.4 per cent; molasses, 2.3 per cent; pure spirits, .8 per cent. Many of the 'agricultural' distilleries are owned by the farmers themselves and worked on their own account, but there are also combinations of smaller farmers which are formed for the purpose of erecting a distillery and operating it in mutual interest, using as raw materials the potatoes and grain produced by their members. . . . The apparatus of these small farmers is generally most primitive, producing 5 to 13 gallons at a time. . . . There are also ambulant distillers, who go from farm to farm and work up the materials of the farmers. . . . The smallest distillery produced 13 gallons, the largest 15,850."

(f) "It is difficult to define the area necessary to render the erection of a distillery profitable. Nearly all the German distillers produce from 13,000 to 26,000 gallons, for the manufacture of which 8,000 to 37,000 bushels of potatoes are necessary."

"Apparatus for obtaining potato spirit containing 35 per cent alcohol, according to the Tralles system, is quoted as follows:

TABLE No. 34.

Capacity. Gallons	Weight. Pounds	Price. Dollars
26.4	330.6	143
52.8	551.1	205
79.2	661.3	238
132	992	314
264.1	1,763	619

In Germany a considerable conservation of both potatoes and cereals for food purposes has been effected by the decision of the government, on account of the war, to cut down the production of alcohol by 40 per cent.

(f) "In Switzerland, during the last five years the average annual consumption of potatoes for distilling has been 22,500 tons, with an average price of 44 cents per cwt. . . . This is only a little more than 5 per cent of the total production of potatoes. . . . It has had a beneficial effect upon the agricultural interests of the country, as potato growers are to a certain extent insured against a too excessive depreciation of their crops."

In Russia more alcohol is produced (or was before the recent ukase against vodka) from potatoes than from all other sources.

(u) "Any scheme for the operation of agricultural distilleries, whether large or small, should provide for the utilization of the by-product known as 'slop.' This is the residium remaining after the alcohol and a small amount of water have been boiled off from the fermented distillery mash. . . . This slop has been found, both in this country and abroad, to be stock food of high value, and should be fed to the stock on the farm that furnishes the raw material. . . . It is allowable to give from 18 to 20 gallons per day in fattening oxen weighing from 1,300 to 1,400 pounds. More than this amount has been found injurious. Milk cows should not receive more than 16 gallons daily. . . . It should be fed fresh and hot."

PRODUCTS OF DRIED POTATOES

In the United States there have been practically no potatoes dried for commercial use. In Germany, however, this is an important part of potato utilization, the dried product being used for stock food, starch manufacture, alcohol, flour (for both starch and as food for man and stock). To a great measure drying solves the problem of the disposal of surplus crops, as it enables the product to be kept until there is a sufficient demand from one or all of the several industries.

(n) The problems to be met in commercial potato drying relate mainly to the present cost of the labor in picking up and delivering to the factory the potatoes not marketable for table use. In many cases, however, it is necessary to remove these culls from the field to prevent the spread of potato diseases, and it would seem that the drier would pay for the labor involved.

(m) "The plant requisite for the drying of 10,000 tons of potatoes during a season of about eight months costs $18,000 to $19,000. The machinery alone, without a press for making the meal into cakes, costs $12,000. For a building $3,000 suffices, the remainder is needed for pumps, motive power, washing vats, etc. The force needed to operate the plant consists of seven men: engineer, stoker, helper, cellarman, two machine men, one to handle the residual liquors. If the final product is to be pressed into cakes the additional cost for plant is about $4,000, and two more operatives are required. Such an installation naturally can be operated with great economy in connection with a distillery or starch factory. In practice it is found that the total cost of preparing

unpressed potato meal by the above method (including interest, depreciation, etc.) is 56 cents per long ton of tubers. The additional cost for pressing into cakes is 12 cents per ton. . . . In practice 3.8 tons of raw potatoes yield one ton of the dessicated product."

(f) "The erection of a potato-drying plant may be considered practicable on a farm of 990 acres on the condition that sufficiently large area is planted in potatoes. For such a plant on a small scale, an investment of at least $2,380 should be figured."

The cultivation of potatoes is far ahead of the manufacture of alcohol and starch, and the quantities used for drying purposes (in Germany) soon will exceed the quantities used in all other branches of the potato industry. It may be said that the drying of potatoes may reach the importance of the German sugar industry. The dried potato is excellent material for the manufacture of alcohol . . . and of compressed yeast. . . . The dried is not a competitor of the fresh potato; it is an entirely different product and never will exercise a harmful influence on the market. On the other hand, drying firms are becoming buyers of fresh potatoes, and anyone who knows the influence the starch industry has had on the German market will be able to appreciate the importance of this fact.

"Distillers and starch converters, after all, use only a small part of the (German) total crop, and the former choose between potatoes and grain according to market conditions. For the present, therefore, the only form of potato utilization which gives much promise of ability to care for future crops of increased magnitude is the drying industry. This industry, first remarked officially in 1903, when there were six establishments in the business, counted 254 drying plants in 1910, and the quantity of potatoes dried, which was 160,539 tons during the season of 1908-09, had reached 332,641 tons during 1909-10. The further development of this industry is being encouraged as part of a well-ordered plan for bringing about, as far as possible, the economic independence of Germany. As Germany now (1914) imports upward of 3,500,000 tons of stock foods, the ultimate hope is that by increasing the potato-drying industry, and also by increasing such crops of other foods that must be mixed with potatoes in order to provide a balanced ration, the time may not be far distant when there will no longer be any need of importing stock foods at all."

(n) In 1910 more than twelve million bushels of potatoes were dried in German factories, which numbered 371 in 1913.

Vice Consul Dreyfus of Berlin reports under date of October 17, 1914:

"Owing to the war Germany's import of cereals is greatly curtailed . . . especial efforts are being made this year to further the conservation of the potato crop. . . . The government already has offered to assist in setting up factories for drying, the cost of each one of which is about $4,760. . . . the purpose being to dry as many as possible during the present season. . . . The sale of potatoes should increase correspondingly with the consumption of potato flour for baking. Many bakers already have made bread with an addition of 10 to 20 per cent of potato flour, of which half was made from dried potatoes. In view of the fact that potato flour is about 8 marks ($1.90) per 100 kilos (220.46 pounds) cheaper than rye flour, this should tend to lower the price of this necessary food product."

(f) "The potato-flour (sometimes called rough starch) industry in the Netherlands was started in 1840. . . . There are now 30 factories for the manufacture of dry potato flour, excluding all other potato products; and 14 others where it is made in other forms for conversion. . . . It is estimated that 2,000 workmen find employment in this branch of industry. The total consumption of potatoes by all the factories, exclusive of those operated cooperatively (7 in number), averages 800,000 tons annually . . . 85 per cent is exported to countries having important textile industries; exports, 1910, 126,118 tons; 1911, 133,941 tons; 1912, 151,123 tons. The total annual output of potato flour in the Netherlands is estimated at 145,200 tons, and that of glucose at 22,000 tons. The price of potato flour varies between $1.60 and $2.40 per 100 pounds."

Consul Ralph C. Busser, Trieste, Austria, November 17, 1914, reports:

"According to a decree of the Austrian government bakers are forbidden, from December 1, 1914, to use more than 70 per cent of wheat flour in the composition of bread, and the remainder may be potato flour. . . . Wheat flour costs today $13.40 per quintal (220 pounds); potatoes, $2.80 per quintal, wholesale. . . . The price of the bread ingredients therefore falls from $13.40 to $9.80."

(a) Washington, D. C., Feb. 14, 1915: "Baking experiments to test the value of making bread of potato meal mixed with wheat flour are now being undertaken by the United States Department of Agriculture's Bureau of Chemistry. This is to test the possibilities of the potato in the same manner as Germany and Austria are now advising their people to do. The increased cost of living throughout the world has emphasized the fact that flour made of other substances than wheat, or of these substances mixed with wheat, might provide people with healthful food quite as nutritious as the pure wheat flour, and at the same time cheaper.

"Austrian bakers are now compelled by law to use at least 30 per cent potato meal in making their bread. The Bureau of Chemistry's potato-meal bread has been baked with from 25 to 50 per cent potato meal and the remaining percentage wheat. The most satisfactory loaves in combining economy and appearance were those made with the minimum percentage allowed in Austria or less. The loaves made with more than 30 per cent potato meal were not so satisfactory as they were heavier and less attractive in form. The bread has a rather coarse texture and dark appearance, but possesses a distinctive and agreeable flavor. It also retains moisture for a much longer period than ordinary wheat bread.

"The Bureau of Chemistry used the imported 'potato flake' in some of its experiments, and in others meal made by slicing, milling and drying potatoes on a small scale in its laboratories. It should be added that such ordinary 'potato flour' as is on our American markets is not the same as the German 'potato flake' or *walz mehl* which has given such satisfactory results in the experiments.

"The question has been raised as to whether the ordinary cooked potato might not be satisfactorily substituted for the prepared potato meal. The experimenters believe that it might serve the same purpose if used in just the right proportion, but this would be difficult for the average housewife to determine as there is great danger of using too much and producing a very soggy loaf. However, the custom of adding a very little potato is already used by many housekeepers to keep their bread moist, and this practice can very well be recommended for more general use.

"The Bureau of Chemistry is making these experiments in spite of the fact that there is a law which makes it difficult for manufacturers to make mixed flour satisfactorily. This law surrounds the manufacture of mixed flour with so many restrictions that the business has not become a popular one. The result is there is very little mixed flour at present manufactured and offered for sale. The Mixed Flour Act was passed in 1898 before there was a Food and Drugs Act, and was passed for the purpose of raising a war revenue at a time when many of the common articles of food did not command so high a price as now.

"The tax of 4 cents which is now imposed on every barrel of mixed flour is not in itself a heavy one; it is the collection of it with the attendant regulations and restrictions that hampers any manufacturer who would like to make such flours.

"It should be stated in connection with the mixing of other materials with wheat flour in making bread that this cannot always be done economically. There must be taken into consideration the prevailing market prices of the commodities to be used.

"This article is written primarily for the purpose of bringing to the attention of the public the fact that in order to obtain good, nutritious and wholesome bread it is not necessary to use an entirely wheat flour. A mixture will in many cases produce a bread which is quite as satisfactory. With this a matter of common knowledge, it is believed in times of over-production and the consequent favorable market prices of substances suitable for mixing with wheat flour that bakers may wish to experiment with certain mixtures. Care should be taken, however, in marketing or selling of bread to which has been added in appreciable amount any ingredient other than wheat, that no deception is practiced and that the consumers are aware of the kind of bread being furnished them."

POTATOES AS STOCK FOOD

(u) The analysis of potatoes, potato skins, and potato "slop" is as follows:

TABLE No. 35.

Material	Nitrogen free extract	Ash	Protein (Nx.6.25)	Ether extract (fat)	Sugar as dextrose	Starch	Crude fibre
Potato	10.55	4.39	10.06	0.29	1.59	70.35	2.26
Potato Skins	38.40	6.51	21.87	2.55	1.44	8.65	20.69
Potato "Slop"	46.24	11.26	30.00	0.69	2.29	2.98	6.54

See chapter on Alcohol, page 26, this bulletin.

TABLE No. 36.—*Comparative Compositions of Ordinary Food Materials.*
(From "The Science of Nutrition," by Graham Lusk, Ph. D., W. B. Saunders, Pub.)

Kind of food material	Inedible refuse of purchased material	Water	Unavailable nutrients	Available nutrients					Food value, water and waste eliminated, per pound
				Protein	Fat	Carbohydrates	Ash	Fuel value per pound = 453.6 grams	
		%	%	%	%	%	%	Calories	%
Potatoes	20.0	78.3	1.4	1.7	0.1	17.7	0.8	370	20.3
Potatoes (boiled and cooked)	.....	75.5	1.7	1.9	0.1	20.0	0.8	415	22.8
Potatoes (mashed and creamed)	.....	75.1	2.0	2.0	2.7	17.1	1.1	475	22.9
Wheat flour, entire	.....	11.4	4.5	10.7	1.7	70.9	0.8	1645	84.1
Wheat flour, baker's grade	.....	11.9	4.2	10.3	1.4	71.7	0.5	1640	83.9
Rye flour	.....	12.9	3.6	5.3	0.8	76.9	0.5	1610	83.5
Corn (maize) flour	.....	12.6	3.6	5.8	1.2	76.3	0.5	1625	83.8
Rice	.....	12.3	3.7	6.5	0.3	76.9	0.3	1610	84.0
Rice, boiled	.....	72.5	1.1	2.3	0.1	23.8	0.2	505	26.4

Taking the last column of Table No. 36 and the average farm values in the United States on December 1, 1913, in cents per bushel, as bases, the following will give an idea of the cost per unit of food value of the foods mentioned:

TABLE No. 37.

Food	Pounds per bushel	Average prices per bushel in U. S. Dec. 1, 1913	Prices per pound	Percentage of food value per pound	Cost per unit of food value in decimals of cents
		Cents	Cents		
Potatoes	60	68.8	1.14	20.3	.0056
Wheat Flour	60	73.4	1.22	84.1	.0014
Rye Flour	56	63.4	1.13	83.5	.0014
Corn Flour	56	69.1	1.23	83.8	.0015
Rice	56	85.8	1.53	84.0	.0018

According to the above, the food values in potatoes cost, per pound of product, four times as much as wheat or rye, and nearly as much more than corn or rice. Or, to put it another way, and considered from the standpoint of monetary cost, each of the other four foods is practically worth four times as much as potatoes, pound for pound.

On the other hand, it is stated that an acre planted with potatoes will yield more than ten, fourteen, or even seventeen times as much food material as will one planted with wheat, rye or peas.

(f) The growing recognition of the value of dried potatoes for stock food arose from the impossibility of feeding them raw in large quantities and the trouble and expense incident to boiling. On July 31, 1910, there were 254 potato-drying factories in operation in Germany, nearly all of them worked in connection with large agricultural undertakings. The amount of raw material treated in the last two years for which figures are available was: In 1908-09 160.539 metric tons; in 1909-10, 332,641 tons.

(h) The German authorities consider their dried potato product to have a feeding value equivalent to 80 per cent of that of American corn.

(n) It is said that there are 19 million swine supported by potato feed in Germany, and that potato tops are now dried and used for stock feed on many estates.

(g) Although there was a decrease, in 1905 from 1900, of 10,119,142 pounds, or 14.9 per cent, in the quantity of cattle food produced in starch factories in the United States, the value increased $250,700, or 97.2 per cent.

(f) The pulp residue from the manufacture of starch—the most important by-product—generally is used for fodder, but it can be so used only if necessary and proportionate amounts of nutritious food substances containing nitrogen are added. It can be used fresh, sour or steamed, and all animals consume it readily if it is fairly dry or has been previously heated.

(s) "Of course dessicated potatoes are supposed to be soaked in water before using and in this way regain somewhat of their original characteristics. Canned dried potatoes are on the market and are prepared for use in camps or wherever it is not convenient to cook food. They may be kept in good condition for a long time, and do not differ greatly from freshly cooked potatoes.

(f) "If raw potatoes are used as stock food, horses and cattle never should be given more than 10 pounds thereof per day, otherwise colic and inflammation of the stomach and intestines are caused. When fed to sheep in greater quantities than 2 pounds per day they cause chlorosis and dropsy. If groats and oil cake are given to the animals the disease is conquered. Boiling and steaming the potatoes also destroys the bad effects. If it is desired to use large quantities as fodder they always should be boiled or steamed. Frozen potatoes should be preserved by being soured in pits or holes. For this purpose the potatoes are steamed, mashed, and put into a pit in alternating layers, each about 6 inches thick, of crushed potato and chopped straw. The top should be well covered with earth—thus protected they keep for years and are a good fodder for cattle and swine. For fattening purposes potatoes are a good feed for cattle and sheep and swine if used in conjunction with the necessary quantity of rough provender and nutritive fodder. Steamed potatoes are more fattening than raw, and animals prefer them.

"Whether boiled or raw potatoes have absolutely no effect upon the quantity or quality of the milk. If necessary to use potatoes for fodder for milk cows, an animal weighing about 1,100 pounds should not be given more than 26 to 33 pounds daily. Fattened and stalled cattle may eat as much as 29 to 55 pounds. Horses should not be fed potatoes at all if they have to work continually. Of the residues of the technical industries, distillers' wash plays an important part as a winter fodder for milk cattle as well as for fattening purposes—the proportion of nutriment is greater than in the potato itself." (For details of distillers' wash as stock food see Special Consular Report No. 64, Department of Commerce; also see paragraph on "slop," in chapter on Alcohol, page 26, this bulletin.)

A. A. Borkind, Professor of Animal Industry, Vermont Experiment Station, says:

"At 15 cents per bushel, potatoes are more costly food for dairy stock than silage; they produce neither more nor better milk. Potatoes are best adapted to hog feeding. In order to secure the best results the potatoes should be cooked so as to be mealy, and be mixed with corn meal or ther ground grains to form a rather heavy mush. In this form they are relished by the swine. Skim milk makes a valuable adjunct to feed with this mixture of potatoes and meal. Potatoes alone cannot be used to advantage as a feed, nor can they be eaten by the hogs in any great quantity. Experiments at Wisconsin and elsewhere show that 450 pounds of cooked potatoes are worth approximately 100 pounds of corn meal for swine feeding."

J. L. Stone, of the Cornell Experiment Station, says:

"For stock food the total digestive nutrients in a ton of potatoes will be slightly more than one-fifth as much as would be contained in a ton of corn meal. The potatoes are even more highly carbonaceous than the corn meal, and naturally would be best fed in conjunction with those feeds that supply an abundance of protein. There is another factor, however, involved, that is of considerable importance. Raw potatoes are a succulent food, and used in connection with a ration that is deficient in succulence (usually one that does not include corn silage) they would have a value above that indicated by the total digestive nutrients. Some succulent food is desirable in all rations, and a moderate amount of such food, when added as above, produces an effect above that which would be indicated by the nutrients present. The writer's personal experience is that as small an amount as half a peck a day fed all dairy cows (lacking other succulence) produces quite a marked effect in the milk flow, and two or three times this amount may be fed to advantage, if the potatoes are available. But they should be introduced into the ration gradually. To avoid danger from choking it is well to run the potatoes through a root cutter. It is impossible to give a cash valuation to a food stuff of this kind, except as a result of careful experiment. It is probable that under ordinary circumstances and the present condition of the grain market, potatoes might be figured at from 15 to 20 cents a bushel for feeding purposes; and if succulence were sadly needed they might reach an equivalent to a valuation of 25 cents a bushel."

(q) "In one test potatoes were buried in a silo filled with crimson clover. They acquired the characteristic color of the plant and the odor developed in fermentation. It was found that they had been cooked by the heat of fermentation and rendered more digestible. Another silo was filled by surrounding about a ton of potatoes with corn (whole plant). Upon opening the corn and potatoes were found in good condition. The potatoes were not as thoroughly cooked as when packed with the clover. As shown by analysis the potatoes ensiled with crimson clover had lost less water than those with the corn. The crushed potatoes when removed from the silo lost weight very rapidly on exposure to the air, and formed a hard mass, containing only 15 to 20 per cent of water. In this condition they could be kept for a long time. When required for feeding they were soaked in water, regaining their softness and digestibility. Another investigator ensiled chopped raw potatoes with two pounds of salt per 1,000 pounds, under pressure of 2,500 pounds per square yard. The total cost of washing, chopping, putting in silo, and weighing 50 tons of potatoes, was about $15. The temperature of the silo when filled was 39 degrees F. When opened sixty-two days later it was 50 degrees. Cattle ate this pulp greedily, alone or mixed with cottonseed cake."

A SUGGESTION

From all of the foregoing a solution of the problem of profitable potato growing and marketing might be found in a cooperative plan that would assure the farmer of his full share of every cent of profit there might be extracted from the business.

To this end it might be advisable to establish a central depot at a convenient shipping point readily accessible to the growers of the district in which the association is formed. To this depot all of the growers would ship all of their potatoes, where they would be inspected and sorted. Only those of the very highest quality in every respect would be marketed for seed and table use, and these carefully packed and sold under a name or brand that would establish their reputation. If this high quality was rigidly maintained and the reputation fully earned and justified (as has been done similarly for apples from certain districts) a premium price above the prevailing market could be commanded, demanded and depended upon. All culls and surplus then could be worked up for industrial purposes and the volume of supply probably would warrant the erection and operation of the necessary plants for drying, starch manufacturing and alcohol distilling. The peelings from the dryer and the residue from it and the starch factory, including the water from the latter, could be used by the distillery for the extraction of all remaining fermentable values. Pulp mash from the distillery, and the "slop," could be returned to the growers for stock food in proportion to their contribution of potatoes or their needs, and all that finally remained returned to the ground for fertilizer. In this way every stage of the operation, every pound of potatoes raised, might be made to yield a profit to the growers. This presupposes and includes mutual efforts for the improvement in quality and quantity of potatoes grown, and for the combatting and eradication of disease. It might be advisable to grow different varieties especially adapted for baking, frying, boiling, and for high starch content. While this plan would be an experiment in its initial stages it is possible that it might be the solution of many of the present difficulties, disappointments and defeats.